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ANNUAL REPORT OF THE MISSOURI RIVER COMMISSION FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., July 8, 1897.

SIR: The Missouri River Commission beg leave to submit herewith their annual report for the fiscal year ending June 30, 1897.

ORGANIZATION AND MEETINGS OF THE COMMISSION.

No change occurred in the personnel of the Commission, which remained throughout the year as follows:

Lieut. Col. Amos Stickney; Corps of Engineers, president.
Garland C. Broadhead.
Richard S. Berlin.
Maj. Thomas H. Handbury, Corps of Engineers, U. S. A.
Maj. William H. Heuer, Corps of Engineers, U. S. A.

By paragraph 1, Special Orders, No. 168, Headquarters of the Army, Adjutant-General's Office, Washington, July 18, 1896, Capt. J. C. Sanford, of the Corps of Engineers, was relieved from duty as secretary of the Commission by Capt. Hiram M. Chittenden, Corps of Engineers, U. S. A. The transfer of duties resulting from this order took place July 29, 1897.

At the meeting of the Commission on July 6, 1897, for the consideration of this report, Mr. C. L. Chaffee, of Omaha, Nebr., appeared, with a commission as member of the Missouri River Commission, duly signed by the President of the United States, and with the required oath of office, which he had taken on that day. He was accordingly admitted as a member, presumably vice Mr. R. S. Berlin, who was absent from the meeting. No other official notification of this change has been received.

The business before the Commission was of such a nature that only one meeting was deemed necessary during the year and this was held at the Commission office in St. Louis, July 15–17, 1896, to consider the annual report for 1896 and to make allotments from the appropriation (river and harbor act) of June 3, 1896.

There were also three meetings of the committee on the improvement of the Osage and Gasconade rivers, viz, July 30, 1896, March 6, 1897, and April 16, 1897.

APPROPRIATION AND ALLOTMENTS.

In the allotments made by the Commission of the appropriation of June 3, 1896, there has been no change except in the transfer of the sum of $5,000 from the allotment for surveys, gauges, and physical data to the work in the vicinity of Nebraska City, Nebr. This transfer was approved by the Chief of Engineers under date of March 30, 1897.

The sundry civil bill of June 4, 1897 contained the following item:

> Improving Missouri River from mouth to Sioux City, Iowa: For continuing improvement of Missouri River from its mouth to Sioux City, Iowa, including salaries, clerical, office, traveling, and miscellaneous expenses of the Missouri River Commission, surveys, permanent bench marks, and gauges, three hundred thousand dollars; of the sum heretofore appropriated for improving the Missouri River, the Secretary of War is directed to expend not exceeding twenty-five thousand dollars to repair and protect the works in the neighborhood of Nebraska City, in the State of Nebraska.

It is proposed to recommend the allotment of the $300,000 appropriated for the fiscal year ending June 30, 1898, as follows:

Improving the Missouri River.

For local works above Kansas City, Mo		$35,000
To include work—		
Near Nebraska City, Nebr	$25,000	
Opposite Leavenworth, Kans	2,000	
Above Atchison, Kans	8,000	
For local works below Kansas City, Mo		94,000
To include work—		
Near the mouth of the Little Blue	$20,000	
At Miami, Mo	22,000	
Above Glasgow, Mo	20,000	
Near Rocheport, Mo	13,000	
At Howard Bend, above St. Charles, Mo	19,000	
For systematic improvement of the first reach		100,000
For operating snag boat		14,000
For surveys, gauges, physical data, and publications		25,000
For office, traveling expenses, and salaries of the Commission		25,000
For repairs and contingencies		7,000
Total		300,000

In the sundry civil bill of June 4, 1897, there is a proviso as follows: "Of the sum heretofore appropriated for improving the Missouri River, the Secretary of War is directed to expend not exceeding $25,000 to repair and protect the works in the neighborhood of Nebraska City, in the State of Nebraska." The sum of $5,000 was allotted by the Commission from the appropriation of June 3, 1896, for the purpose named, and this allotment was approved by the Secretary of War. This action, it is believed, fulfills the requirement of the above-mentioned act. To make a more thorough improvement at this point and to insure the protection of previous work an allotment of $25,000 is made from the appropriation of June 4, 1897.

It is also proposed to recommend the transfer of the unexpended balance of $1,295.56 from the allotment for surveys or examinations at special localities named in the river and harbor act of June 3, 1896, to the allotment for surveys, gauges, physical data, and publications.

SURVEYS AND EXAMINATIONS.

The maps of the Missouri River at present in use (edition of 1890) are on a scale of 1 inch to the mile, and are based upon a system of secondary triangulation extending from the mouth to Sioux City. There was no detailed topographical survey. The main topographical features only were represented, and these were either taken from the maps of the preliminary surveys of 1878–79 or were sketched in for short distances back from the immediate banks of the river.

To supply the deficiencies of the present maps and provde a complete contour map of the valley from bluff to bluff, extending from the mouth to Sioux City, Iowa, based throughout upon actual instrumental surveys, a project for this purpose was adopted by the Commission at its meeting September 6, 1894.

The survey began in October, 1894, and had continued upstream, the point at present reached being Lexington, Mo., 322 miles from the mouth.

The allotment for surveys, gauges, and physical data for the past fiscal year was considerably reduced from that of the preceding year, and it was not the expectation of the Commission that any field work on the general topographical survey of the Missouri River would be done during the year. It was found, however, that the allotment would permit a small amount of work to be done, and a party, under Assistant Engineer F. B. Maltby, was accordingly put in the field about the middle of August and continued at work until the middle of October. The general survey was carried from Dewitt, Mo. (the limit of previous work), to Lexington, Mo., a distance of 51½ miles.

In addition to this work, special surveys were made by the same party of five localities designated in the river and harbor act of June 3, 1896, viz, at, or in the vicinity of, Rocheport, Mo., Glasgow, Mo., Miami, Mo., St. Charles, Mo., and mouth of Little Blue River, Missouri. This work was done under a special allotment of $6,000.

The details of these surveys are given in the report of Mr. F. B. Maltby, assistant engineer, Appendix A.

Special surveys were also made by Assistant Engineer Yonge, at Nebraska City, Nebr., Atchison, Kans., and Leavenworth, Kans.

No surveys were made on the Osage or Gasconade rivers.

In the office the topographical surveys have been mapped on a scale of 1 inch to 1,000 feet, and in addition the special surveys have been platted and tracings made, showing recent changes in the bank lines.

The notes of the 1895 surveys on the Gasconade River were all platted, making 13 sheets, covering 29.5 miles of river. The work has not yet all been inked.

GAUGES AND PHYSICAL DATA.

On the Missouri River 22 permanent gauges were maintained throughout the year independently of those maintained in connection with the works of improvement.

Through the courtesy of the engineer officer in charge of the river above Sioux City, the records of the gauges at Bismarck and at Townsend were also furnished this office.

Reports of all of these 26 gauges were received weekly, and a hydrograph of each record kept platted up to date. Of the 18 cable gauges there were only three renewals of duplicate cables required during the year, at an expense of less than $2 each.

Three of the inclined wooden gauges have also needed but slight repair, but the one at Waverly was entirely renewed in November.

The shore gauges gave the usual trouble in low water of having to use a temporary one during such time.

Only one inspection trip was made during the year—November 9 to December 4—when everything about the gauges was placed in good condition, and beyond a few known slight discrepancies, they are still in good condition.

Of the 12 pilot bulletins between the mouth and Kansas City, 11 of them were withdrawn from use during December, January, February, and March, but the one at Kansas City was exhibited during the entire year in accordance with a written request of local steamboat interest.

The four permanent gauges on the Osage and the one on the Gasconade River, referred to in last years' report, have been continued. See report of Assistant Engineer A. H. Blaisdell, Appendix B.

Assistant Engineer Seddon, in addition to the routine duties of his office, has made special studies upon data collected in regard to the emptying and filling of locks, upon the probable effects of the proposed dam at Lock No. 1, Osage River, on the flood flow of that stream, and upon the recent floods of the Mississippi River and its tributaries. (See Appendix L.)

As a matter of useful information relating to the navigation of the Missouri River, a list of the steamboat wrecks which have occurred on the river from the beginning of steamboat navigation down has been prepared. The information so collected embraces the name and description of boat, trade engaged in, date, locality and cause of wreck, with additional data in many cases. An analysis of these data, showing the principal causes of steamboat disasters, is given in the special report of Captain Chittenden, Appendix D. See also list of bridges, Appendix E.

CONSTRUCTION.

OMAHA, NEBR., AND COUNCIL BLUFFS, IOWA.

This work was under the charge of the secretary of the Commission, with Assistant Engineer Samuel H. Yonge in immediate control.

The present project, approved by the Chief of Engineers August 10, 1896, provides for the completion of the longitudinal training dike and the system of cross dikes designed to restore the shore line at the deep bend about a mile above the Interstate Bridge, and also to make the necessary repairs to the existing works in that vicinity. The project was in reality only a completion of that of 1895.

The plant for the prosecution of the work was mostly taken from that previously used on the Osage division of the first reach. It was towed to the locality of the work, and reached there on the 20th of September. Work was immediately begun and was carried on continuously until December 19, when the plant had all been secured on the bank, and the force of employees furloughed or discharged.

Operations were resumed immediately upon the breaking up of the ice in the spring, the launching of the plant having been completed on the 3d of April. Operations were concluded May 10 by the completion of the project, and the plant was sent to Nebraska City, Nebr., for work at that point.

The work at Omaha and Council Bluffs under the last project was conducted under considerable difficulty, particularly that done during the spring high water, but it was nevertheless completed very nearly on time and within the limit of the allotment provided for it.

For the details of the work see the report of Mr. S. H. Yonge, United States division engineer, Appendix F.

NEBRASKA CITY.

This work was under the charge of the secretary of the Commission until May 31, and since that time under the charge of the president of the Commission. Mr. Samuel H. Yonge, United States assistant engineer, has been in local charge.

The last work executed by the Commission in this vicinity was the revetment of 5,750 linear feet of bank of Nebraska City Island, completed in 1890.

In the fall of 1896, the head of this revetment commenced to undermine, and a caving pocket formed in the bank just above, due to changes in the channel, through a reef extending a long distance up the river. In May, 1896, about 400 linear feet of the revetment had been washed out, and the pocket having enlarged to about 900 feet in width, the safety of the remainder of the revetment was imperiled. It was proposed to check the enlargement of the pocket by constructing three short dikes across it.

Piles and other material, based on soundings taken in March, 1897, had been procured, but when the plant was ready at the site to begin work on May 11, it was found that the depth of water in the pocket had been much increased by scour and that most of the piles were too short.

It was not practicable to procure longer piling before the expected June rise, which would further injure the old work unless protection works were at once put in; the project was slightly changed by substituting two 3-row dikes for the proposed three 2-row ones, and the adding of a short 2-row structure in the eddy a short distance below.

The requirements for long piling were partly overcome by procuring cottonwood piles in the near vicinity, and by splicing the shorter pine piles already on hand.

Dikes Nos. 1 and 2 are 131 and 130 feet long respectively and were built at an average cost of $1,755 each.

The short dike below cost about $264. Work was commenced on May 19 and was completed on June 21, several suspensions of work being necessary on account of high water.

In bracing the dikes, besides the usual direct top braces and wales, diagonal cable stays and direct ground braces were used, the latter detail being used for the first time.

A full explanation of the method of bracing and the means employed is given in the report of Mr. Samuel H. Yonge, assistant engineer, Appendix G.

The changeable channels through the reef, before referred to, also produced a caving of the banks in the Nebraska City side of the river, which, if allowed to continue, would endanger the safety of the city water works and other municipal interests.

An examination, disclosing the fact that bed rock existed too near the surface to build protecting works of piles, it was decided to riprap the bank with stone at three places or sections of 50 linear feet each where apparently it was most needed.

This work at the end of the fiscal year is about one-third completed.

SYSTEMATIC IMPROVEMENT OF FIRST REACH.

This work has been under the charge of the president of the Commission. Mr. S. Waters Fox, United States division engineer, was in local charge of the Gasconade Division during the entire year, and of the Osage division after September 6, when he relieved Mr. S. H. Yonge, division engineer.

The river and harbor appropriation act of September 19, 1890, directed that with certain specified exceptions the appropriation therein made for the Missouri River below Sioux City, Iowa, should be expended in systematic improvement of the river from its mouth up, in reaches to be designated by the Commission. In accordance with these provisions, the above portion of the river was, for purposes of systematic improvement, divided into six reaches, the first of which extends from its mouth to the mouth of the Osage River, a distance of 141 miles. The improvement of the first reach was begun in the summer of 1891, near the head of the reach, and has since been continued under the subsequent appropriation acts. To obtain a proper heading for the work it was found necessary to go about 14 miles above the mouth of the Osage, to the head of Murrays Bend, from which point the work thus far done extends about 45 miles downstream, or to the mouth of the Gasconade River. For convenience of administration, these 45 miles have been divided into the Osage division and the Gasconade division. The Osage division extends from the head of Murrays Bend to Isbell Station; the Gasconade division from the latter point to the mouth of the Gasconade River.

The Commission's annual reports for 1895 and 1896 contain a general description of the works, whether then finished or proposed, for the improvement of the river within the above 45 miles.

OSAGE DIVISION.

The work of the year has been done under an allotment of $164,000 from the appropriation of June 3, 1896, for continuing the systematic improvement of the first reach, and in accordance with project approved by the Chief of Engineers August 26, 1896.

Junction of Osage and Missouri rivers.—The project for bringing the Osage into the Missouri above Dodds Island and closing the chute south of the island was adopted in accordance with a resolution of the Missouri River Commission of July 17, 1896. This work necessitated a cut for a new channel for the Osage River through Osage Point; the degrading of Dikes 25 and 26; the closing of the breach on Dike 19 B; the construction of Dike 19½ A; the removal of a portion of Dike 19 B; the degrading of the inshore portion of Dike 19 B, the Osage Dam, and the Osage Point revetment, and other minor works, the nature of which would be dependent upon these above described.

Cut through Osage Point.—The only work done on this part of the project was the acquisition of the right of way, and the quarrying of about 11,093 cubic yards of rock for revetment of the left bank of the new channel.

Degrading Dike 25.—Between the 3d and 6th of December the outer 42 feet of dike and 50 feet of its trail were cut down to an elevation of 2.2 feet above standard low water.

Degrading Dike 26.—This work was accomplished between the 4th and 8th of December.

Dike 19 B.—The closing of gap at shore end was commenced October 13 and completed October 23. The removal of that portion which lay within proposed Osage Channel was begun December 3 and continued throughout the winter as weather and stage of river would permit. The degrading of that portion of the dike beyond the limits of low water was begun at the same time.

Dike 19½ A.—This structure is intended to constitute (with an earthen embankment) the left bank of the Osage River from Osage Point to its junction with the Missouri. It was begun on October 16 and completed November 28. The winter floods did it considerable damage, that of January injuring 310 feet of curtain, and the April rise developing a breach in the dike, and scouring a waterway around the west end of the structure. These damages were repaired and the dike extended to 19 A by June 25 of the present year.

OTHER DIKE WORK.

Sheer Dike 29A.—The purpose of this dike is to ward off drift from Dike 29A. The structure, which consists of clusters of three piles each, spaced 25 feet apart, and located at an angle of 60 degrees with the dike, was constructed between October 23 and October 30. This dike served its purpose perfectly, and, although it suffered some injury from drift, it protected entirely the main dike.

Degrading Dike 29A.—Three hundred feet of this dike was lowered to 2.6 feet above standard low water at outer end, 5.4 feet above at inner end. This work was done between November 25 and December 3.

Dike 34.—Extended 191 feet between October 31 and November 24.

Dike 35.—Extended 247 feet between November 2 and November 25.

Dike 36.—A breach 109 feet long was repaired.

Dike 29B.—A small breach in this dike was closed between April 17 and April 20.

REVETMENT REPAIRS.

Murrays Bend.—Various small breaches in this revetment, which occurred at different times during the year, were repaired.

DAMAGE TO WORKS.

Damages of a more or less serious nature were caused by the floods to Dikes P, 19A, 19½A, 19B, 30, 32, 29A, 29B, and I.

PLANT.

The plant underwent no extensive repairs during the year, but a considerable amount of small repairing was done. In accordance with instructions from the Secretary of War, dated April 20, the steamers *Golden Gate* and *Alert* were sent to the Lower Mississippi on flood-relief duty. They left the boat yards April 23, and returned, the *Alert* May 19 and the *Golden Gate* May 23.

SURVEYS.

Various special observations and surveys were made during the year, the principal being a survey of the locality at the mouth of the Osage River, the low-water survey of the Osage division, and numerous observations upon scouring effect of the current around the ends of the dikes.

For details of the work see the report of Assistant Engineers S. Waters Fox and Samuel H. Yonge, Appendices I and H.

GASCONADE DIVISION.

The operations of the year comprised revetment and dike construction, as well as the repairing of both kinds of work, the construction of an experimental bank-head designed as a substitute for revetment, the care and repair of plant, surveying, the preparation of projects and maps with estimates of cost, examinations and special reports on conditions at several points outside of first reach, and miscellaneous incidental work.

The work was done under an allotment of $164,000 for continuing the systematic improvement in first reach, and in accordance with the project approved by the Chief of Engineers August 26, 1896.

REVETMENT.

Heckmann Island No. 3.—The project for improvement of Straubs Bend contemplated the protection of the south bank of the island by a revetment extending from the head of the island well into Boatwrights Chute. Work began August 12 and was completed September 24.

Repairs.—The aggregate length of revetment on the Gasconade division is now 8.9 miles, and all in excellent condition. Only a very small amount of repair work has been necessary.

DIKE WORK.

Two entirely new dikes were built in this division, viz, XI A and XI B, their purpose being to fair up the middle section of Chamois Bend.

Dike XI A.—Work on this dike was begun June 14 and completed June 27. The structure is 240 feet long. The first four bents are 2-row and the others 3-row work.

Dike XI B.—Work began June 11, and was nearly completed when, on the night of June 24, a severe storm partially destroyed the dike. This was followed by a sudden rise of the river, which suspended operations on June 28.

Dike XXXII.—Work had been commenced on this dike early in the spring, but had been suspended on account of high water. It was resumed on the 10th of August and completed on the 26th of the same month.

Dike XXXIV.—Work on this dike had also been commenced in the spring, but was suspended on account of high water. It was resumed October 5 and completed October 31.

Dike XXIII.—Work was begun on this dike on October 5 and completed October 31.

Dike XV.—The extension of this dike to the project line was commenced November 2 and completed December 6.

DIKE REPAIR AND ALTERATION.

Repair work was confined to three dikes, I B, I A, and XX A, which had received injuries from the floods of May, 1896. The new work on the last-mentioned dike was altered from the original plan of 4-row work into 2-row in the outer breach and to 3-row work inshore; that on dikes I B and I A to 2-row from 3-row, as originally planned.

BANK-HEAD.

An experimental device called a bank-head was built at the foot of Chamois Bend, about 3,850 feet below the lower end of the revetment. It is intended, by means of the bank-head, to firmly hold the bank at that point, and it is expected that the stretch of bank between it and the revetment will become stable after a certain amount of recession, and that, these conditions having obtained, there will be no necessity for revetting this stretch of bank, as originally proposed.

The structure was practically completed by March 26. Although it was subjected to a very severe test by a change in the line of approaching flow, due to other influences some 2 miles up river, the structure stood well. Its influence on the conditions of flow was in close accord with expectations. It has so far accomplished the object for which it was built, in that the 3,850 feet of bank above has not receded from erosion beyond a certain line, and the original bank below for a distance of about 1,800 feet has been protected. The cost of the bank-head complete was $11,265. The 5,000 linear feet of continuous revetment which it has replaced would have cost $35,000. (See report of Assistant Engineer S. Waters Fox, Appendix J.)

REMOVAL OF OBSTRUCTIONS.

The snag boat belonging to the Commission began the work of removing snags at the mouth of the Missouri River on August 8. It proceeded upstream as far as Lexington, Mo., turning back from there September 15 and working downstream to Jefferson City.

The boat was taken from this point to St. Louis on an inspection trip September 21–25.

The boat returned to the Missouri September 30 and worked upstream to New Frankfort, Mo., turning back on October 24 and working downstream to the mouth, where she arrived November 6. She left the next day for her winter quarters at Paducah, Ky.

She left Paducah March 8 and came to St. Louis, where she underwent some repairs and waited for the high water to subside. On May 13 she resumed snagging in the Missouri River at its mouth and worked upstream to Lexington, Mo., where she removed the wreck of the ferryboat *Eagle*. She turned back from Lexington June 17, and worked down to Chamois, where she was laid up for the summer. The total number of snags removed during the year was 1,203, weighing 13,087 tons. There were 316 trees cut, 11 drift piles, and 289 dike piles removed, and the total distance run was 2,258 miles.

OSAGE RIVER.

The project for the improvement of this stream, adopted in 1871, consisted in the removal of obstructions to navigation, such as snags and leaning timber, in deepening the channel over shoals by means of dredging, and in the construction of cross and wing dams to concentrate the water over the shoal places.

The original estimated cost of the project was $230,000, but afterwards the work was made to cover more ground than was originally intended, and for a number of years past no estimate of the cost of the improvement by this method has been rendered in the annual reports. From the nature of the project, which contemplates only temporary relief from year to year, and the removal of obstructions which are constantly forming anew, no definite time can be fixed for its completion, and no estimate made of its ultimate cost. The improvement must be continuous, and the annual estimates must depend upon conditions as they arise.

The amount expended by the General Government under this project to June 30, 1897, is $230,947.49, of which sum $2,754.39 was expended during the past fiscal year. The result has been a temporary benefit to navigation along the river for a distance of about 245 miles above the mouth.

The operations of the season began August 17, 1896, at Osceola, Mo., and continued downstream to the mouth. The work accomplished includes the removal of 499 snags and 661 drift trees, the felling of 294 trees, and the scraping of 450 yards of gravel from a bar in Kirkman Shoal. The total distance run was 210 miles.

The construction of a lock and dam near the mouth of the river was authorized by the river and harbor act of September 19, 1890. The estimated cost was $200,000.

The approved project for Lock No. 1 contemplated a structure of stone masonry, the interior dimensions being 276 feet between quoins by 52 feet wide. As stated in the last annual report, a material change in the original plans was made necessary in consequence of the effect which the Missouri River improvements had had upon the stage of water in the lower course of the Osage. No satisfactory adjustment of the contract price for the additional work having been found possible, authority was obtained for terminating the contract then in force for the construction of the lock and for the purchase of the contractor's plant and material. The contract was surrendered and the transfer made on the last day of the fiscal year ending June 30, 1896.

Up to this time the work under this project included the acquisition of lands and construction of a dwelling and office, the building of a cofferdam and the excavation of the interior to the amount of 17,000 cubic yards, the opening of a quarry in the bluff back of the lock, and some dredging in the river below the lock.

The above change in the original plan for constructing Lock No. 1 was so important that it was thought advisable to prepare a revised project better suited to the new conditions. A partial project, as revised, was approved by the Chief of Engineers November 23, 1896, and the complete project for lock and dam was approved June 29, 1897.

Work under the revised project was begun July 17 and continued until suspended by high water early in January, 1897. Great difficulty was encountered in making the necessary excavation inside the cofferdam, owing to the excessive inflow of water, but the work was finally accomplished, and the driving of the piles for the foundation was completed shortly before the suspension of the work.

Gravel was dredged from the bed of the Osage River near the lock, and Missouri River sand from the Osage Chute in quantities sufficient for the entire construction of the lock and dam. Cement, timber, iron, and other materials, sufficient for the construction of the lock have also been purchased, and most of them have been delivered, and everything is in readiness for a resumption of work as soon as the high water subsides sufficiently. Negotiations are in progress for the purchase of additional land for the erection of buildings at the site of the lock.

The amount expended under the project for lock and dam to June 30, 1897, is $112,947.78, of which sum $60,314.81 was expended during the past fiscal year.

For the details of the work see reports of Captain Chittenden and Assistant Engineers Maltby and Seddon, Appendixes K, M, and L.

GASCONADE RIVER.

The project for the improvement of this stream, adopted in 1880, consisted in the removal of snags and logs from the channel and of leaning timber from the banks of the river where necessary, and the construction of wing dams and training walls to concentrate the flow of water upon the shoals to increase the depth over them.

From the nature of the project, which contemplates only temporary relief from year to year, and the removal of obstructions which are constantly forming anew, no definite time can be fixed for its completion, and no estimate made of its ultimate cost. The improvement must be continuous, and the annual estimates must depend upon conditions as they arise.

The original estimated cost of the project was $50,000, and the principal work contemplated by it has been accomplished, but for reasons just stated the work can never be considered completed.

The amount expended under the project to June 30, 1897, is

$61,249.99, of which sum $4,653.44 was expended during the past fiscal year, and the river has been kept reasonably free from obstructions for a distance of 108 miles above the mouth.

The work of the past season began about the middle of September, and continued until the middle of November. It consisted, as heretofore, mainly in the removal of snags, the building of dikes, and in surveys of places requiring improvement. Work was done at the following points: Bocks Bar, Woodpecker Island, and Stake Shoal.

The number of snags removed was		91
Overhanging trees cut		10
Drift trees cut		20
Rock quarried	cubic yards..	1,077
Dike constructed	linear feet..	1,020

For details of work, see report of Mr. L. P. Butler, United States assistant engineer, Appendix N.

GENERAL REMARKS.

The progress of the work for systematic improvement of the river by continuous work by reaches, which was started in 1891, has been seriously interfered with during the past year by the requirements of the river and harbor act of June 3, 1896, which specified numerous localities, separated by many miles, where work was to be done, notwithstanding the fact that the amount of money appropriated was largely reduced from that of previous years. In order to carry out the work indicated, it was necessary to break up the organization of the work in one of the divisions of the First Reach, in order to supply forces and plant for detached works. The Osage Division was seriously disorganized for this reason, and the work that was done in that division during the year was placed under the direction of the Gasconade Division engineer, and it has been considered necessary for economical reasons to discontinue the Osage Division altogether, merging it into the Gasconade Division. The work in the Gasconade Division has been much restricted.

The work heretofore done upon the First Reach has extended from about 4 miles above Jefferson City to the Gasconade River, a distance of 45 miles, the whole length of the reach to the mouth of the river being 141 miles. The results obtained have shown beyond any question the practicability of controlling the river, holding its banks, and giving ample channels for navigation, but the cost and uncertainty of permanence of the work and slowness of progress have been such as to discourage the public and the National Congress in the effort to improve the river for such a distance as would give promise of the building up of its commerce and the benefiting of the general public to a degree commensurate with the cost of the work. The effect of this is plainly visible in the reduction of the appropriations, and the yielding to demands for the application of considerable portions of the reduced appropriations to detached works in scattered localities, where the interests of navigation do not require immediate work, and where the only objects to be attained are the protection of local private interests.

The Commission and their executive officers have, during the past year, given much study and effort to the vital question of reduction of cost of work, in the hope that it might be so reduced as to make that part of the improvement of the river confided to the Commission such, in cost, efficiency, and rate of progress, as would insure early and sufficient benefit to the general public, and to such a degree as to commend the improvement as being wise and worthy of its making.

It is believed that much progress has been made toward a very great decrease in the cost of work that will not only be efficient in accomplishing the purposes of the improvement, but in making it permanent. The principal work on the river consists of dikes for regulating the width and directing the channels and work for protection of banks. Modifications of dike construction and new methods of bank protection have been tried, with most promising results; but it is yet too early in the progress of these efforts to assert with perfect confidence that the entire work of improvement can be made at a very great decrease from the cost of methods heretofore used. Unceasing efforts will be put forth to accomplish a result so much to be desired.

For some of the details concerning these efforts, attention is invited to the appended reports of Mr. S. H. Yonge, in charge of Omaha work, and Mr. S. Waters Fox, in charge of the Gasconade division, Appendices F and J.

For commercial statistics see report of Assistant Engineer A. H. Blaisdell, Appendix C.

RECOMMENDATIONS AND ESTIMATES.

MISSOURI RIVER.

The act of July 13, 1892, provided for continuous annual appropriations for the river for a period of four years, and the provisions of the three succeeding appropriation acts permitted a concentration of effort in the systematic improvement of the river by continuous work. The results obtained were quite remarkable and the work was carried on in an exceedingly satisfactory manner. In the act of June 3, 1896, while provision was made for four years' work, the amount of annual appropriations was very much reduced and it was provided that considerable portions of the appropriations should be expended on scattered localities. The result of the latter act has been to seriously disarrange the systematic work, and the small amounts of the appropriations have made it impossible to keep up the plant, a considerable amount of which has been disposed of during the year, having become unserviceable, and not replaced.

It is earnestly urged that when it may be deemed proper to provide for work at specified localities on the river not included in the systematic work in progress separate additional appropriations should be made, so that the systematic work and the maintenance of plant may not be left unprovided for by the diversion of funds to other purposes.

In the last annual report the Commission stated that it was expected to largely reduce the cost of future work and that it was believed that the improvement of the first reach could be completed for considerably less than the amount previously estimated in the preceding annual report, viz, between $3,000,000 and $3,500,000. There has been a reduction in the cost of the work, and it is believed there will be considerable further reduction in the future, but until more progress has been made in this direction, no definite reduction of estimate is deemed advisable.

Any reduction of cost, however, must necessarily be largely dependent upon appropriations being made in sufficiently large sums to warrant systematic continuous work.

OSAGE RIVER.

When the work of constructing the dam is commenced it is of the utmost importance that it be completed in a single season. To permit the annual floods for five or six months to pass over it in a partially completed state would cause so much damage as to increase greatly the cost of the work. The entire sum necessary for this work ought to be appropriated at once or authority be granted to contract for its completion. The estimate for snagging and removal of other obstructions is the same as in the last annual report.

GASCONADE RIVER.

The estimates for work under the existing project are the same as for last year. The sum actually appropriated, viz, $5,000, has been found insufficient to accomplish the necessary work of two years.

Estimates for continuing works of improvement for the fiscal year ending June 30, 1899.

Improving Missouri River from mouth to Sioux City, Iowa, including office and traveling expenses and salaries of Commission, surveys, gauges, physical data and publications, operating snag boat, and systematic improvement of first reach	$1,000,000
Improving Osage River, Mo.:	
For completion of lock and dam	146,000
Snagging, etc	4,000
	150,000
Improving Gasconade River, Mo.:	
Snagging, etc	15,000

Money statements.

IMPROVING MISSOURI RIVER FROM MOUTH TO SIOUX CITY, IOWA.

July 1, 1896, balance unexpended	$399,249.49
Refunded on account of overpayment	3.92
Amount appropriated by sundry civil act approved June 4, 1897	300,000.00
	699,253.41
June 30, 1897, amount expended during fiscal year	311,126.69
July 1, 1897, balance unexpended	388,126.72
July 1, 1897, outstanding liabilities	22,829.78
July 1, 1897, balance available	365,296.94
Amount that can be profitably expended in fiscal year ending June 30, 1899	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

IMPROVING OSAGE RIVER, MISSOURI AND KANSAS.

July 1, 1896, balance unexpended		$121,694.62
June 30, 1897, amount expended during fiscal year		60,314.81
July 1, 1897, balance unexpended		61,379.81
July 1, 1897, outstanding liabilities	$5,022.17	
July 1, 1897, amount covered by uncompleted contracts	14,760.00	
		19,782.17
July 1, 1897, balance available		41,597.64
Amount (estimated) required for completion of existing project, lock and dam		146,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1899:		
Lock and dam	$146,000.00	
Snagging	4,000.00	
		150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

IMPROVING GASCONADE RIVER, MISSOURI.

July 1, 1896, balance unexpended	$5, 157.40
June 30, 1897, amount expended during fiscal year	4, 653.44
July 1, 1897, balance unexpended	503.96
July 1, 1897, outstanding liabilities	30.00
July 1, 1897, balance available	473.96
Amount that can be profitably expended in fiscal year ending June 30, 1899	15, 000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Respectfully submitted.

AMOS STICKNEY,
Lieutenant-Colonel of Engineers, U. S. A.,
President Missouri River Commission.
GARLAND C. BROADHEAD.
THOS. H. HANDBURY,
Major, Corps of Engineers, U. S. A.
W. H. HEUER,
Major Engineers.
C. L. CHAFFEE.

Financial statement from July 1, 1896, to June 30, 1897.

Work.	Amount available July 1, 1896 (balance of appropriation).						Appropriation act of June 3, 1896.	Appropriation act of June 4, 1897.	Refunded on account of overpayment, etc.	Received by transfer from other allotments.	Total available.
	Act of Sept. 19, 1890.	Act of July 13, 1892.	Act of Mar. 3, 1893.	Act of Aug. 17, 1894.	Act of Aug. 18, 1894.	Act of Mar. 2, 1895.					
Improving Missouri River from mouth to Sioux City, Iowa.											
Repair of revetment in Belmont Bend			$260.92								$260.92
Systematic improvement, first reach						$56,381.19	$164,000.00				220,381.19
Operating snag boat						18,526.75	20,000.00				38,526.75
Office and traveling expenses and salaries of Commission						9,043.90	20,000.00		$1.08		29,044.98
Surveys, gauges, physical data, and publications						5,709.47	20,000.00		2.84		25,712.31
Surveys or examinations							6,000.00				6,000.00
Rectification of the river at—											
Omaha, Nebr					$321.85		40,000.00				40,321.85
Atchison, Kans					8,841.02		15,000.00				23,841.02
St. Joseph, Mo					48.34						48.34
Leavenworth, Kans					116.05		15,000.00				15,116.05
Near Nebraska City, Nebr										$5,000.00	5,000.00
Continuing improvement								$300,000.00			300,000.00
Total			260.92		9,327.26	89,661.31	300,000.00	300,000.00	3.92	5,000.00	704,253.41
Improving Osage River, Missouri and Kansas.											
Lock and dam (construction of lock and accessories)	$90.89	$36,854.15		$34,522.78			45,000.00				116,467.82
Snagging operations		226.80					5,000.00				5,226.80
Total	90.89	37,080.95		34,522.78			50,000.00				121,694.62
Improving Gasconade River, Missouri.											
Removal of snags and other obstructions				157.40			5,000.00				5,157.40
Total				157.40			5,000.00				5,157.40
Grand total	90.89	37,080.95	260.92	34,680.18	9,327.26	89,661.31	355,000.00	300,000.00	3.92	5,000.00	831,105.43

Detailed statement, July 5, 1884, to June 30, 1897—Continued.

Work.	Balances of appropriations of 1882.	Appropriations and allotments.	From sales, etc.	Total available.	Expended to May 31, 1897.	Expended during the month of June, 1897.	Total expended to June 30, 1897.	Total balances June 30, 1897.	Outstanding liabilities June 30, 1897.	Balances available June 30, 1897.
Sioux City, Iowa	....	$80,411.67	....	$80,411.67	$80,411.67	....	$80,411.67	....	....	....
Continuing improvement	....	300,000.00	....	300,000.00	....	....	....	$300,000.00	....	$300,000.00
Total	$1,982.80	5,960,000.00	$1,891.09	5,963,873.89	5,553,494.45	$21,752.72	5,575,247.17	388,126.72	$22,829,78	365,296.94
Improving Osage River, Missouri and Kansas.										
Lock and dam (construction of lock and accessories)	....	171,855.18	....	171,855.18	112,733.14	214.64	112,947.78	58,907.40	19,681.17	39,226.23
Snagging operations	....	9,366.44	....	9,366.44	6,774.03	120.00	6,894.03	2,472.41	101.00	2,371.41
Examination of the stream	....	800.00	....	800.00	800.00	....	800.00	....	....	....
Total	....	182,021.62	....	182,021.62	120,307.17	334.64	120,641.81	61,379.81	19,782.17	41,597.64
Improving Gasconade River, Missouri.										
Removal of snags and other obstructions	....	9,638.11	....	9,638.11	8,884.15	250.00	9,134.15	503.96	30.00	473.96
Examination of the stream from mouth to Arlington	....	500.00	....	500.00	500.00	....	500.00	....	....	....
Total	....	10,138.11	....	10,138.11	9,384.15	250.00	9,634.15	503.96	30.00	473.96
Grand total	14,827.19	6,392,159.73	1,467.42	6,408,454.34	5,936,106.49	22,337.36	5,958,443.85	450,010.49	42,641.95	407,368.54

Consolidated statement, July 5, 1884, to June 30, 1897.

IMPROVING MISSOURI RIVER FROM MOUTH TO SIOUX CITY, IOWA.

Act of July 5, 1884		$640,000.00
August 5, 1886		375,000.00
August 11, 1888		1,000,000.00
February 22, 1890		75,000.00
September 19, 1890		800,000.00
July 13, 1892		600,000.00
March 3, 1893		700,000.00
August 18, 1894		700,000.00
March 2, 1895		710,000.00
June 3, 1896		300,000.00
June 4, 1897		300,000.00
Total specific appropriations		$6,200,000.00
Balances from former appropriations:		
Act of August 2, 1882, applied to works above Sioux City, Iowa	$4,000.00	
Survey of Missouri River from mouth to Fort Benton	8,844.39	
Act of August 5, 1886, applied to removing obstructions from Missouri River	1,982.80	
Total balances		14,827.19
Received from sales and deposits		1,467.42
Total		6,216,294.61

IMPROVING OSAGE RIVER, MISSOURI AND KANSAS.

Act of August 17, 1894	$46,000.00	
Act of June 3, 1896	50,000.00	
Balances transferred January 15, 1895, from Maj. Chas. J. Allen, Corps of Engineers:		
Act of September 19, 1890	42,655.18	
Act of July 13, 1892	43,366.44	
Total		182,021.62

IMPROVING GASCONADE RIVER, MISSOURI.

Act of August 17, 1894	$5,000.00	
Act of June 3, 1896	5,000.00	
Balance transferred January 15, 1895, from Maj. Chas. J. Allen, Corps of Engineers:		
Act of July 13, 1892	138.11	
Total		10,138.11
Grand total		6,408,454.34
Expended to June 30, 1897:		
For improving Missouri River	$5,828,167.89	
For improving Osage River	120,641.81	
For improving Gasconade River	9,634.15	
Total		5,958,443.85
Balance June 30, 1897		450,010.49

List of civilian engineers employed on work of river and harbor improvements in charge of Missouri River Commission from July 1, 1896, to June 30, 1897, inclusive, in connection with improving Missouri River from its mouth to Sioux City, Iowa (under river and harbor acts of August 18, 1894, March 2, 1895, and June 3, 1896); improving Osage River, Missouri and Kansas (under river and harbor acts August 17, 1894, and June 3, 1896); improving Gasconade River (under river and harbor act of June 3, 1896).

Name and residence.	Time employed. Mos.	Time employed. dys.	Compensation per month.	Where employed.
Saml. H. Yonge, Nebraska City, Nebr	2	0	$250	First reach, Osage Division.
	6	0		Omaha and Council Bluffs, Omaha Division.
	2	0		Atchison, Omaha Division.
	2	0		Nebraska City, Omaha Division.
S. Waters Fox, Chamois, Mo	12	0	250	First reach, Gasconade Division.
A. H. Blaisdell, St. Louis, Mo	12	0	200	St. Louis, Mo.
Jas. A. Seddon, St. Louis, Mo	12	0	200	Do.
Theo. Schoonmaker, Osage City, Mo	10	0	200	Osage River, construction of lock and dam.
F. B. Maltby, St. Louis, Mo	8	0	175	St. Louis, Mo.
	2	0		In field.a
	2	0		Do.b
O. H. B. Turner, St. Louis, Mo	7	0	150	St. Louis, Mo.
	2	0		In field.a
	0	9	100	First reach, Gasconade Division.
Saml. F. Crecelius, St. Louis, Mo	8	0	125	St. Louis, Mo.
	2	0		In field.a
	2	0		Do.b
E. J. Thomas, St. Louis, Mo	7	0	125	St. Louis, Mo.
	2	0		In field.b
L. P. Butler, St. Louis, Mo	3	0	150	In field, Gasconade River.
	9	0	125	St. Louis, Mo.
Ed. Jones, Omaha, Nebr	1	0	125	First reach, Osage Division.
	5	6		
	3	2		Nebraska City, Nebr.
W. R. De Witt, Gasconade, Mo	12	0	125	First reach, Gasconade Division.
A. H. Weber, Omaha, Nebr	0	21	125	Omaha, Nebr.
	1	4		Atchison, Kans.
R. A. Crawford, Osage City, Mo	9	0	125	First reach, Osage Division.
	1	0		First reach, Gasconade Division.
S. W. Benedict, Osage City, Mo	5	0	100	First reach, Osage Division.
	4	0		First reach, Gasconade Division.
J. Wm. Link, St. Louis, Mo	1	9	110	In field.a
W. H. Roper, St. Louis, Mo	1	9	110	Do.a
J. L. Johnson, St. Louis, Mo	1	9	90	Do.a
E. D. Williams, St. Louis, Mo	1	0	100	St. Louis, Mo.
Louis R. Hope, Denver, Colo	0	4	150	In field.b
E. Whiting, Laramie, Wyo	0	4	150	Do.b

a On survey, Missouri River.
b On survey, examination of reservoir sites in Wyoming and Colorado.

Abstract of proposals opened September 8, 1896, for furnishing articles enumerated below, in accordance with letter of August 24, 1896, from this office.

CEMENT, NATURAL HYDRAULIC (3,000 BARRELS).

No.	Name and address of bidder.	Name of manufacturer.	Brand or trade-mark.	Approximate date of grinding.	Guaranteed number of pounds in barrel.	Price per barrel delivered at Osage City, Mo.	Price per barrel delivered at Lock No. 1.
1	Thorn & Hunkins Lime and Cement Co., St. Louis, Mo.a	Western Cement Co.	Hulme Star.	Within 30 days from date of shipment.	265	$1.03	$1.11
2	W. T. Berthelet, Milwaukee, Wis.b	Milwaukee Cement Co.	Keystone	Fresh at the time of shipment.	280	1.02	....
3	B. Wallis & Co., Baltimore, Md.	Cumberland Hydraulic Cement Manufacturing Co.	Cumberland Hydraulic Cement.	One week prior to shipment.	300	1.70	....

a No guarantee with proposal; informal; cement to be tested at mills by Mead & Shaw, engineers, Louisville, Ky.
b This bid accepted, subject to inspection and acceptance at Milwaukee, Wis.

APPENDIX A.

ANNUAL REPORT OF MR. F. B. MALTBY, ASSISTANT ENGINEER.

ST. LOUIS, *April 30, 1897.*

CAPTAIN: I have the honor to very respectfully present the following report of surveys made under my direction during the summer of 1896:

Verbal instructions received from you were to make the special surveys "at or near the mouth of Little Blue, in Jackson County, Mo.," "Miami," "from the foot of Bowling Green bend to the head of Harrison's Island," at "Rocheport" and "St. Charles," as mentioned in the river and harbor bill of June 3, 1896; also to extend the topographical survey of the Missouri River from the upper limit of the work already completed, as far as possible, and keep the entire expenditure for field work within $5,000.

In pursuance of the above instructions, a party was organized, consisting of F. B. Maltby, chief of party, O. H. B. Turner, E. J. Thomas, S. F. Crecelius, J. William Link, and W. H. Roper, as topographers, J. L. Johnson, levelman, and the necessary number of recorders, axmen, boatmen, cooks, etc., the entire party numbering thirty-seven men.

I left St. Louis August 17, 1896. Work was begun at Dewitt, Mo., August 22. The work was completed, party discharged, and I returned to St. Louis October 16, 1896.

The party was subsisted and quartered on board the U. S. steamer *Golden Gate.* This arrangement proved very satisfactory and very much simplified the matter of moving the party from place to place. The entire cost of running the steamer was $967.97 for the two months' service. Owing to the short time the boat was in commission, the cost of running from the boat yard at Gasconade to and from the locality where work was performed, was a large part of the entire operating expenses. The river distance covered by the steamer was about 440 miles.

In accordance with written instructions from Lieut. Col. Amos Stickney, Corps of Engineers, U. S. A., president Missouri River Commission, dated September 29, 1896, special surveys as enumerated above were made as follows:

AT OR NEAR THE MOUTH OF LITTLE BLUE, IN JACKSON COUNTY, MO.

The survey began just above Blue Mills Landing and was carried about 3 miles below Missouri City, a river distance of 10 miles. The main bank lines and the shore lines of all islands and bars and their elevations above the St Louis City directrix were located. A tracing has been prepared showing the result of this survey; also the bank lines as surveyed in 1889; also the amount of caving, in acres, from 1889 to 1896.

AT MIAMI.

This was within the limits of the regular topographical survey of the season. A tracing has been prepared showing the result of this survey and giving the topographical features of the entire river valley between bluffs and from Millers Island to Dewitt. This tracing also shows the bank lines in 1890 and the amount of caving from 1890 to 1896.

FROM THE FOOT OF BOWLING GREEN BEND TO THE HEAD OF HARRISONS ISLAND.

The main bank lines and shore lines of islands and bars between the above-mentioned limits were located. A tracing has been prepared showing these lines; also the bank lines in 1890 and 1895, and also the amount of caving from 1890 to 1896.

ROCHEPORT.

A survey was made of the right bank above Rocheport to show the amount of caving; also in the vicinity of Huntsdale for the same purpose. A tracing of the survey of 1895 was prepared which shows this survey; also the bank lines of 1890; also the amount of caving, in acres, from 1890 to 1896.

AT ST. CHARLES.

Surveys were made in the vicinity of St. Albans and opposite Tavern Rock; also in Howards Bend, to show the amount of caving. Tracings have been prepared, showing the topography of the valley in these localities made from the survey of 1895. They show also the recent surveys and the bank lines in 1890; also the amount of caving, in acres, from 1890 to 1896.

The topographical survey of the Missouri River and its adjacent valley was begun at Dewitt, Mo., at the upper limit of the work of 1895 and was carried upstream to about 1¼ miles below Lexington, Mo., a channel distance of 51¼ miles.

The methods and scope of the work were the same as fully described in my report published in the annual report of the Missouri River Commission for 1896.

The total cost of the field work, including the cost of operating the steamer *Golden Gate*, was $4,920.28. Attached hereto is a tabulated statement giving in detail the amount of the various kinds of work performed, cost, etc., on the topographical survey, and not including special surveys. There is also attached a table showing the amount of caving, in acres, as referred to in the above report on special surveys.

On completion of the field work Messrs. Turner, Thomas, and Crecelius were retained in the office, and since that time and up to April 1st, when Messrs. Thomas and Turner were furloughed, have been engaged in mapping the results of the season's work and completing the maps of the surveys made in 1895. The topographical surveys are being mapped on a scale of 1 inch equals 1,000 feet, and on charts covering various lengths of river, the lower end of No. 1 being at the mouth of the river and the upper end of No. 12 being at Lexington, the upper limit of this season's work. Of these maps, the first nine are complete, with titles, notes, and authorities. No. 10 is about complete, with the exception of the title. Nos. 11 and 12 are projected, notes platted and outlines drawn in pencil, and the inking and lettering well begun.

In addition to above mapping, the results of the special surveys have all been platted and tracings made showing the changes in bank lines, as referred to in report above. The usual amount of miscellaneous tracing and maps has been made and called for.

Very respectfully, your obedient servant,

F. B. MALTBY, *Assistant Engineer.*

Capt. HIRAM M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

Work done on topographical survey between Dewitt, Mo., and Lexington, Mo., season of 1896.

Secondary triangulation stations occupied	6
Tertiary triangulation stations occupied	134
Base lines measured	6
Miles of stadia line run	457.3
Miles of main bank located	95.5
Miles of shore line located (including islands and bars)	142.5
Miles of bluff line located	52.5
Miles of river surveyed	51.5
Square miles of topography surveyed	137.8
Number of stadia points located	17,571
Section corners located	22
Bench marks located	45
Miles of levels run	114
Number of single days on which topography was taken	126½
Number of square miles of topography for each observer per working day	1.09
Cost of field work per square mile of topography	$30.67
Number of rations served	1,948
Cost per served ration	$0.531

Amount of caving, in acres, at various points on Missouri River, as determined by special surveys of 1896.

Locality.	Bank.	Time in caving.	Acres.
Opposite Blue Mills Landing	Left	7 years	35
Opposite Atherton, Mo	Right	7 years	111
Do	Left	7 years	142
Opposite Missouri City	Right	7 years	211
Below Missouri City	Left	7 years	114
Thomas Bend	Left	6 years	236
Opposite Miami, Mo	Left	6 years	95
Miami Bend	Right	6 years	120
Little Missouri Bend	Left	6 years	129
Above Wilhoite Bend	Right	6 years	210
Wilhoite Bend	Left	6 years	144
Diana Bend	Right	6 years	159
Opposite Rocheport	Right	6 years	12
Vicinity Huntsdale	Left	6 years	74
Augusta Bend	Left	5 years	370
Opposite Tavern Rock	Left	6 years	225
Howards Bend	Right	6 years	270

APPENDIX B.

ANNUAL REPORT ON WATER GAUGES, BY A. H. BLAISDELL, ASSISTANT ENGINEER.

MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1897.

CAPTAIN: I have the honor to submit the following report on the water gauges maintained by the Missouri River Commission during the fiscal year ending this date. Permanent gauges have been maintained at twenty-two stations on the Missouri River during the year, of which seventeen were wire cable gauges on bridges and the remainder inclined and vertical wooden gauges on shore.

On August 15, 1896, a wire cable gauge on the county road bridge at Townsend, Mont., 2,504 miles above the mouth, which had been established and maintained by the Commission since October 1, 1891, was transferred to the engineer officer in charge of the Missouri River above the southern limits of Sioux City, Iowa.

In connection with the rectification works on the first reach of the Missouri River, three temporary gauges have been maintained throughout the year, and one for three-fourths of the year.

The gauges were unusually free from accidents. The only radical repair required was the placing of a new shore gauge at Waverly, Mo., the old one having been crushed by ice. Some few of the cable gauges required the renewal of their duplicate cords and weights, a matter of slight expense.

Only one complete tour of gauge inspection was made during the year, viz, November 9–December 4. Were it not for the shore gauges, one inspection per year would be sufficient for the service, but in order to secure a continuity of readings, these gauges, being not only liable to injury by ice and drift or displacement by frost, are not infrequently deserted by the channel, and sometimes require both repair and change of location.

The gauge observers employed by the Commission have by their long terms of service become exceedingly expert in their work, and are able to maintain their guages in face of obstacles where less experienced men would fail.

The pilot-bulletin service, maintained at twelve stations below Kansas City, was discontinued November 30, except at Kansas City, where, at the request of local steamboat men, it was made continuous and resumed on April 1. These bulletins exhibit the existing stage, reading from a zero to 5 feet below standard low water, and correspond closely with the readings of the Weather Bureau gauges.

Abstracts of the weekly gauge reports have been mailed two days after the close of each week to the field parties, current hydrographs have been kept platted to date, and the corrected hydrographs of the previous year have been completed in ink.

Through the courtesy of the engineer officer in charge of the Missouri River between Stubbs Ferry, Mont., and the lower limits of Sioux City, the records of the upper river gauges have been made available for use by the Commission, reports from two of which—Bismarck, N. Dak., and Townsend, Mont.—have been received weekly.

On the Osage River four permanent gauges have been maintained, viz, at the Osage City Bridge, site of Lock No. 1, and at 22 and 60 miles above the mouth, respectively.

On the Gasconade River one permanent gauge has been continued, located 30 miles above the mouth.

Beyond an unusual rise in the river of from 9 to 14 feet early in January, due to heavy rains, principally in the Osage and Gasconade valleys, the only marked characteristics of the stages for the fiscal year were the unusual high stages prevailing during the month of April of from 1 to 2.5 feet above standard high water. In the great flood year of 1881 the April stage, which was the maximum, exceeded that of 1897 by from 3 to 7 feet, but in no other year since 1872, in the river below Kansas City has there been higher water during the month of April than in 1897.

Very respectfully, your obedient servant,

A. H. BLAISDELL, *Assistant Engineer.*

Capt. H. M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

APPENDIX O.

ANNUAL REPORT ON COMMERCIAL STATISTICS BY A. H. BLAISDELL, ASSISTANT ENGINEER.

REPORT ON COMMERCE OF MISSOURI RIVER DURING CALENDAR YEAR 1896.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1897.

SIR: I have the honor to submit the following report on the commerce of the Missouri River between its mouth and the southern limits of Sioux City, Iowa, during the calendar year 1896.

Previous to 1895, when the jurisdiction of the Missouri River Commission included the port of Sioux City, some commerce belonging to that port was included in the statements returned by this office, but footnotes under the tables herewith give the amount of such trade.

No change in the method of obtaining the amount of commerce carried on has been made from that adopted in previous years.

With few exceptions, steamboat men and others who carry on a considerable amount of traffic fill out with commendable promptness and accuracy the blanks furnished them and state in great detail the kinds and amount of freight handled, and points between which the shipments are made. In some cases the use of the original freight books is extended for making up the returns.

Among the smaller class of shippers considerable correspondence usually ensues, and sometimes personal investigation, before their returns are satisfactorily rendered, and some of the small amounts are never obtained.

Each water-gauge observer reports on special cards all steamboats, barges, rafts, etc., which pass his station, with details of the trade as far as he can ascertain them, and this list serves as a check on the accuracy of the returns made by the shipper.

The tables showing tonnage and measurements of steamers engaged in the trade are compiled from their inspection papers in the custom house at which they are enrolled or licensed.

Table 1, giving the amount of freight carried, towed, or rafted and number of passengers carried in 1896, is believed to be a close approximation to the actual trade.

TABLE 1.

Class.	Grain.	Live stock.	Wood and lumber.	Sand and building materials.	Miscellaneous farm produce and general merchandise.	Total.	Mile-tons.	Passengers.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*		*No.*
Long-trade packets	898.1	539.2	47.4	27	1,656.4	3,168.1	443,614.1	375
Short-trade packets and miscellaneous boats	19,119.3	3,907.9	11,284.4	14,218.6	4,265.8	52,796	1,064,568.1	1,538
Sand and wood steamers and barges	....	....	181.5	229,437	....	229,618.5	281,204.5	.....
Rafts	....	....	3,147.6	....	....	3,147.6	45,395.2	.....
Mattress brush furnished and towed under contract for United States improvement of Mississippi River	....	....	126.6	....	....	126.6	3,798	.....
Mattress brush furnished and towed under contract for United States improvement of Missouri River above southern limits of Sioux City, Iowa	....	....	67.5	....	....	67.5	1,051	.....
Total	20,017.4	4,447.1	14,855	243,682.6	5,922.2	288,924.3	1,839,630.9	1,913

The following comparative table gives the totals for the different classes of trade for the series of years 1896–1892:

TABLE 2.

Class.	Total number of tons carried.				
	1896.	1895.	1894.	1893.	1892.
Long-trade packets	3,168.1	7,778.8	8,621.6	19,310.9	30,372.3
Short-trade packets and miscellaneous boats	52,796	46,449.5	46,829.7	73,248.5	110,449.1
Sand and wood steamers and barges	229,618.5	175,453.1	95,572.8	146,827.9	91,092.6
Rafts	3,147.6	2,983.6	3,310.7	10,578	4,908.9
Mattress brush furnished and towed under contract for United States improvement of Mississippi River	126.6	22,500	....	....	....
Mattress brush furnished and towed under contract for United States improvement of Missouri River above southern limits of Sioux City, Iowa	67.5	....	....	....	....
Total	288,924.3	255,165	154,334.8	249,965.3	236,822.9

Class.	Mile-tons.				
	1896.	1895.	1894.	1893.	1892.
Long-trade packets	443,614	1,010,379	1,045,526	4,098,147	6,112,180
Short-trade packets and miscellaneous boats	1,064,568	965,536	729,862	753,605	1,411,529
Sand and wood steamers and barges	281,205	240,988	156,346	235,998	327,562
Rafts	45,395	76,655	141,850	579,215	522,701
Mattress brush furnished and towed under contract for United States improvement of Mississippi River	3,798	675,000	....	....	....
Mattress brush furnished and towed under contract for United States improvement of Missouri River above southern limits of Sioux City, Iowa	1,051	....	....	....	....
Total	1,839,631	2,968,558	2,073,584	5,666,965	8,373,972

Class.	Passengers.				
	1896.	1895.	1894.	1893.	1892.
Long-trade packets	375	1,175	3,150	3,700	4,450
Short-trade packets and miscellaneous boats	1,538	5,373	a 3,312	b 8,532	c 41,823
Total	1,913	6,548	6,462	12,232	46,273

a Including 1,000 excursion passengers, 583 of which were above southern limits of Sioux City, Iowa.
b Including 6,200 excursion passengers.
c Including 34,693 excursion passengers.

From Table 2 it is seen that the long-trade packet business in 1896 was less than that of 1895 by over one-half, while the other items of the river's commerce show a slight increase over that year.

At the beginning of the season two packets—the *Libbie Conger* and the *Benton*—were engaged in the long trade, extending their trips as high up as Arrowrock, 221 miles above the mouth, and their books showed a fairly profitable and an increasing business. Both boats had made six trips, but unfortunately were both lying at the St. Louis wharf on May 27, 1896, the date of the disastrous cyclone. The *Conger* suffered a total loss, while the *Benton* was badly wrecked, and, not being repaired until late in the season, did not again enter the trade.

The decrease in mile-tons is due to the loss of these steamers, as the usual number of trips made by these boats is one trip per week.

No new lines of transportation have been established during the year.

Table 3 gives the number and total registered tonnage of steamboats engaged in trade on the Missouri River for the years 1889–1896.

TABLE 3.

Enrolled at—	1896.		1895.		1894.		1893.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
St. Louis, Mo	21	1,970.05	21	1,902.15	17	1,445.54	20	2,282.49
Kansas City, Mo	7	484.20	8	600.03	7	562.03	11	2,932.42
St. Joseph, Mo	3	47.50	3	47.50	3	47.50	3	47.50
Omaha, Nebr	[a] 8	447.68	[b] 8	447.68	[c] 12	866.72	11	911.99
Burlington, Iowa	....	....	2	443.85	1	340.49	2	450.84
Cincinnati, Ohio	....	....	....	....	....	....	1	134.92
Dubuque, Iowa	....	....	....	....	....	....	1	58.32
La Crosse, Wis	....	....	2	359.45	....	....	....	....
Nashville, Tenn	....	....	....	....	1	172.76	....	....
Rock Island, Ill	....	....	....	....	1	188.59	....	....
St. Paul, Minn	....	....	1	106.64	....	....	....	....
Total	39	2,919.43	45	3,907.80	42	3,623.63	49	6,818.48

Enrolled at—	1892.		1891.		1890.		1889.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
St. Louis, Mo	24	2,562.78	19	2,504.31	18	1,840.61	16	1,812.66
Kansas City, Mo	12	2,980.08	18	3,398.13	17	1,270.33	15	1,626.26
St. Joseph, Mo	3	148.88	5	265.41	5	277.62	5	277.62
Omaha, Nebr	11	912.29	12	794.21	10	504.72	13	1,329.85
Dubuque, Iowa	1	58.32	....	....	....	....	....	....
New Orleans, La	1	358.31	....	....	....	....	....	....
St. Paul, Minn	1	324.09	....	....	....	....	....	....
Louisville, Ky	....	....	....	....	1	1,130.34	....	....
Total	58	7,344.75	54	6,962.06	51	5,023.62	49	5,046.39

[a] Five of these did not go below southern limits of Sioux City, Iowa.
[b] Six of these did not go below southern limits of Sioux City, Iowa.
[c] Ten of these did not go below southern limits of Sioux City, Iowa.

Four gasoline boats on the river carried an aggregate of 6,411 tons (58,980 mile-tons) during the year.

The number of boats passing six of the gauge stations is given in the following table:

TABLE 4.

Locality.	Number of steamers passed.		Registered tonnage.	
	Up.	Down.	Up.	Down.
Bellefontaine Bridge, Mo	19	22	4,836.97	4,991.72
Coles Creek, Mo	199	202	12,659.16	12,864.82
Jefferson City, Mo	51	50	7,386.21	7,343.16
Boonville, Mo	123	122	6,061.59	6,006.23
Lexington, Mo	12	11	873.21	817.85
Sioux City, Iowa, Lower Bridge	8	8	219.53	219.53

Unreasonably high rates of insurance on the river have been continued without change since 1889.

TABLE 5.—*List of steamers plying on the Missouri River and tributaries in the district of New Orleans, enrolled at the port of St. Louis, Mo., in the year 1896.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
A. W. Ewing	Osage City, Mo	1878	May 6, 1896	......	......	......	*a* 4
Annie Dell	Hermann, Mo	1889	Aug. 3, 1896	70	16.6	2	19.05
Benton	Pittsburg, Pa	1875	Aug. 29, 1896	197	33	5	394.08
Black Diamond	Portland, Mo	1885	June 20, 1895	72.5	14.4	2.3	18.40
Commodore	Newhaven, Mo	1890	July 10, 1896	97	23.2	3.2	86.45
Eagle	Madison, Ind	1879	May 7, 1896	85.9	21	3.3	55.36
Edna	Boonville, Mo	1887	Sept. 30, 1896	102	21.5	4.7	80.35
Fawn	Hermann, Mo	1880	May 4, 1896	91.9	19.1	3.4	73
Frederick	Tuscumbia, Mo	1883	May 6, 1896	96.4	14.3	3	82.51
Gasconade	Hermann, Mo	1891	May 8, 1896	107.4	23.9	3.5	74.35
J. W. Spencer	Jeffersonville, Ind	1882	May 6, 1896	131	35	5	188.59
John R. Hugo	Evansville, Ind	1879	May 7, 1896	127	20	3	136.88
Kingfisher	Gasconade Falls, Mo	1895	Sept. 30, 1896	74.6	16.1	2.5	27.03
Libbie Conger	Dubuque, Iowa	1878	Apr. 11, 1896	168	29.5	4.5	324.09
May Bryan	Jeffersonville, Ind	1875	Nov. 10, 1896	115	28	4.5	97.40
Mill Boy	Hermann, Mo	1893	Feb. 18, 1896	89.2	18.8	2.8	41.10
Pauline	Louisville, Ky	1890	Apr. 20, 1896	95	23.5	3.3	60.35
Peerless	Hermann, Mo	1894	Feb. 18, 1896	96.6	21.4	3.5	60.41
Pin Oak	do	1888	May 8, 1896	95	17.5	2.2	43.15
Wildwood	Rock Island, Ill	1894	Mar. 9, 1896	99.5	20.8	4	78.50
Harry	Warsaw, Mo	1895	July 10, 1896	47	8	......	*a* 5

Name.	State rooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues, each boiler.	
												Number.	Diameter.
							In.	*Feet.*		*Feet.*	*In.*		*Inches.*
A. W. Ewing	....	....	8	....	8	1	6	$\frac{8}{12}$	1	3	40	*b* 70	$1\frac{1}{2}$
Annie Dell	....	....	20	....	20	2	6	2	1	10	36	*b* 14	3, $3\frac{1}{2}$
Benton	6	18	28	8	20	2	$15\frac{1}{2}$	5	3	24	38	2	$13\frac{1}{2}$
Black Diamond	....	....	10	....	10	2	6	3	1	14	30	*b* 21	3
Commodore	....	....	50	....	50	2	10	4	1	20	44	6	2–12 4–6
Eagle	....	....	15	....	15	2	8	2	1	14	44	4	10
Edna	....	....	20	....	20	2	8	$3\frac{4}{12}$	1	14	44	10	6
Fawn	....	....	50	....	50	2	8	2	1	14	42	4	2–10 2–12
Frederick	4	13	28	13	15	2	7	$2\frac{1}{2}$	1	14	36	6	6
Gasconade	3	6	35	5	30	2	9	$3\frac{1}{2}$	1	20	42	6	6–10
J. W. Spencer	....	....	....	....	......	2	16	6	2	26	40	....	15
John R. Hugo	6	10	39	9	30	2	$12\frac{1}{2}$	$3\frac{1}{2}$	1	24	42	5	10
Kingfisher	....	....	10	....	10	2	5	3	1	14	36	*b* 33	3
Libbie Conger	28	52	50	40	10	2	17	4	2	24	37	5	8
May Bryan	...	....	21	....	21	1	16	5	1	22	44	5	2–12 3–10
Mill Boy	....	....	20	....	20	2	8	1	1	14	44	1 *b* 26	24 3
Pauline	....	....	....	....	......	2	11	3	1	24	40	2	15
Peerless	2	4	22	....	22	2	8	3	1	16	42	2 *b* 36	15 3
Pin Oak	....	....	20	....	20	2	8	$2\frac{1}{2}$	1	17	40	*b* 36	3
Wildwood	....	....	....	....	......	2	11	4	1	20	42	10	6
Harry	....	....	25	....	25	2	4	$\frac{7}{12}$	1	$4\frac{10}{12}$	42	1 *b* 25	20 3

a Estimated.

b Tubes.

TABLE 5.—*List of steamers plying on the Missouri River and tributaries in the district of New Orleans, enrolled at the port of St. Louis, Mo., in the year 1895*—Continued.

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Iron or steel.	When built.	Steam pressure allowed.		
			Lbs.		
A. W. Ewing	Steel	1885	125	Mississippi and tributary rivers.	C. C. Turner, Osage City, Mo.
Annie Dell	Steel	1889	130	do	W. L. Heckmann, Mount Sterling, Mo.
Benton	Iron	1873	115	do	T. B. Sims, St. Louis, Mo.
Black Diamond	Steel	1886	130	do	L. L. Kurzebaum, Carthage, Mo.
Commodore	Steel	1890	153	do	D. N. Burruss, Miami, Mo.
Eagle	Iron	1872	100	Missouri and tributary rivers.	M. T. Moore, Jefferson City, Mo.
Edna	Steel	1887	154	Mississippi and tributary rivers.	C. C. Turner, Osage City, Mo.
Fawn	Iron	1880	110	do	Chas. B. Able, St. Charles, Mo.
Frederick	Steel	1888	150	do	R. M. Marshall, Tuscumbia, Mo.
Gasconade	Steel	1891	160	do	Hermann Ferry and Packet Co., Hermann, Mo.
J. W. Spencer	Steel	1883	150	Missouri River, 10 miles above and below Jefferson City, Mo.	Cole and Callaway Transportation Co., Jefferson City, Mo.
John R. Hugo	Steel	1894	160	Mississippi and tributary rivers.	R. M. Marshall, Tuscumbia, Mo.
Kingfisher	Steel	1895	140	do	Wm. L. Heckmann, Mount Sterling, Mo.
Libbie Conger	Steel	1878	165	do	
May Bryan	Iron	1875	113	Missouri River between St. Charles and 10 miles above Hermann.	Washington Ferry Co., Washington, Mo.
Mill Boy	Steel	1893	110	Mississippi and tributary rivers.	Hermann Ferry and Packet Co., Hermann, Mo.
Peerless	Steel	1893	160	do	Do.
Pauline	Steel	1883	160	do	James Short, St. Charles, Mo.
Pin Oak	Steel	1888	116	do	E. W. Wild, Hermann, Mo.
Wildwood	Steel	1881	166	do	James Short, St. Charles, Mo.
Harry	Steel	1895	140	Osage River	Henry Kellar, Warsaw, Mo.

TABLE 6.—*List of steamers plying on the Missouri River and tributaries in the district of New Orleans, enrolled at the port of Kansas City, Mo., in the year 1896.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions. Length.	Dimensions. Breadth.	Dimensions. Depth.	Total tonnage.
				Feet.	*Feet.*	*Feet.*	
Annie Cade	Leavenworth, Kans	1879	May 9, 1896	127.5	32	4.5	178.32
Joseph L. Stephens	Jeffersonville, Ind	1887	May 7, 1896	103	29.4	4.2	85.95
Laura	Arrowrock, Mo	1895	Dec. 22, 1896	83.3	16.4	3.6	38.10
Lois	Waverly, Mo	1896	Nov. 11, 1896	75.2	18.9	3.1	35.29
Plow Boy	Sioux City, Iowa	1884	May 7, 1896	70	18	3	37.80
Roy Lynds	Jeffersonville, Ind	1887	May 8, 1896	87	25	3.6	64.19
Urie	Osceola, Mo	1890	June 9, 1896	80	20.2	3.1	44.56

Name.	Passengers. Permitted to carry.	Passengers. Steerage or deck.	Engines. Number.	Engines. Diameter.	Engines. Stroke.	Boilers. Number.	Boilers. Length.	Boilers. Diameter.	Boilers. Flues in each boiler. Number.	Boilers. Flues in each boiler. Diameter.
				Inches.	*Feet.*		*Feet.*	*Inches.*		*Inches.*
Annie Cade	....	....	1	20½	5½	2	16	42	....	....
Joseph L. Stephens	....	....	2	10	3½	1	16	48	....	....
Laura	25	25	2	7	3	1	12	40	7	6
Lois	20	20	2	7	2½	1	12	40	*a* 34	3
Plow Boy	10	10	2	8	2	1	14	40	*a* 40	3
Roy Lynds	....	....	2	9	3	1	18	42	....	....
Urie	....	....	1	10	1 $\frac{2}{12}$	1	13½	42	*a* 36	3

Name.	Boilers. Iron or steel.	Boilers. When built.	Boilers. Steam pressure allowed.	Licensed to run on—	Name and address of sole or managing owner.
			Lbs.		
Annie Cade	Iron	1879	119	Missouri River, 5 miles above and below Kansas City.	William A. Cade, Kansas City, Mo.
Joseph L. Stephens	Steel	1887	125	Missouri River, between Boonville and opposite shore.	Mary E. Brent, Boonville, Mo.
Laura	Steel	1891	150	Mississippi and tributary rivers.	Gustav Moehle, Arrowrock, Mo.
Lois	Steel	1896	110	Missouri River, 30 miles above and below Waverly, Mo.	J. D. Thomas, Waverly, Mo.
Plow Boy	Steel	1889	150	Mississippi and tributary rivers.	D. N. Smith, Boonville, Mo.
Roy Lynds	Steel	1887	161	Missouri River, between Lexington and opposite shore.	Lexington Ferry, Coal and Transportation Co., Lexington, Mo.
Urie	Steel	1890	120	Osage River	M. J. Wright, Osceola, Mo.

a Tubes.

TABLE 7.—*List of steamers plying on the Missouri River and tributaries, in the district of New Orleans, enrolled at the port of St. Joseph, Mo., in the year 1896.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
Bee	St. Joseph, Mo	1893	June 11, 1896	53.5	13.5	3.5	16.42
Harry Lynds	Whitecloud, Kans	1892	Apr. 6, 1896	64	18	3	27.08
Princess	St. Joseph, Mo	1889	June 11, 1896	......	......	......	*a* 4

Name.	Passengers.		Engines.			Boilers.				
	Permitted to carry.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues in each boiler.	
									Number.	Diameter.
				Inches.	*Feet.*		*Feet.*	*Inches.*		*Inches.*
Bee	10	10	1	8	1	1	11 10/12	34	*b* 28	3
Harry Lynds	20	20	1	7	10/12	1	7	30	1 *b* 13	12 3
Princess	16	16	1	4½	5/12	1	3	24	*b* 20	1½

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Iron or steel.	When built.	Steam pressure allowed.		
			Lbs.		
Bee	Steel	1887	112	Mississippi and tributary rivers.	H. W. Dunn, St. Joseph, Mo.
Harry Lynds	Steel	1895	160	Missouri River, 10 miles above and below Whitecloud.	J. H. Lynds, Whitecloud, Kans.
Princess	Iron	1891	125	Mississippi and tributary rivers.	W. E. Jamison, St. Joseph, Mo.

a Estimated. *b* Tubes.

TABLE 8.—*List of steamers plying on the Missouri River and tributaries, in the district of New Orleans, enrolled at the port of Omaha, Nebr., in the year 1896.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
Capitola Butt	Montrose, Iowa	1885	June 15, 1896	83.7	23.3	3.3	57.31
Castalia *a*	Sioux City, Iowa	1892	.....do	110	26.2	3.7	90.06
Josie L. K. *a*	Chamberlain, S. Dak	1884	June 16, 1896	60	14	2.5	22.45
Little Maud *a*	Sioux City, Iowa	1882	June 17, 1896	92	20	3.4	58.66
Mary E. Bennett *a*	Covington, Nebr	1888	June 15, 1896	65	14	2.5	21.71
Minnehaha *a*	Canton, S. Dak	1893	.....do	......	......	......	*b* 8
Queen No. 2	Tieville, Iowa	1879	June 12, 1896	44	12	2	12.00
Vint Stillings	Montrose, Ill	1881	June 15, 1896	131	31.6	4.8	177.47

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.			Flues in each boiler.	
			Permitted to carry.	First cabin.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Number.	Diameter.
							In.	*Feet.*		*Feet.*	*In.*		*Inches.*
Capitola Butt	....	....	20	....	20	2	11	3½	1	20	46	10	7
Castalia *a*	6	12	22	7	15	2	10	4	1	20	42	4 2	6 10
Josie, L. K. *a*	....	....	30	....	30	2	6	1	1	6$\frac{5}{12}$	42	*c* 52	2½
Little Maud *a*	....	....	....	....	....	2	10½	3	1	24	40	....	....
Mary E. Bennett *a*	....	....	....	....	....	2	7½	2$\frac{11}{12}$	1	16	38	5	8
Minnehaha *a*	...	....	40	....	40	1	4	$\frac{5}{12}$	1	6	24	*c* 31	2
Queen, No. 2	....	....	....	....	....	1	7½	$\frac{5}{16}$	1	7½	30	....	....
Vint Stillings	....	....	37	....	37	1	20	5	2	22	42	5	10

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Iron or steel.	When built.	Steam pressure allowed.		
			Lbs.		
Capitola Butt	Steel	1885	120	Missouri and tributary rivers.	R. A. Talbot, Covington, Nebr.
Castalia *a*	Steel	1892	160	Mississippi and tributary rivers.	B. S. Holmes, Sioux City, Iowa.
Josie L. K. *a*	Steel	1888	120	Missouri and tributary rivers.	Yankton Bridge and Ferry Co., Yankton, S. Dak.
Little Maud *a*	Steel	1889	150	Missouri River, between Niobrara and Fort Randall.	Joseph Leach, Running Water, S. Dak.
Mary E. Bennett *a*	Steel	1891	177	Mississippi and tributary rivers.	R. A. Talbot, Covington, Nebr.
Minnehaha *a*	Steel	1894	140	Floyd and Big Sioux rivers.	J. W. Clarige, Sioux City, Iowa.
Queen No. 2	Iron	1877	110	Missouri River at ferry crossings.	Anderson & Kilbaum, Decatur, Nebr.
Vint Stillings	Iron	1878	125	Missouri River, 35 miles above and below Sioux City.	Selzer Bros., Sioux City, Iowa.

a Did not go below southern limits of Sioux City, Iowa. *b* Estimated. *c* Tubes.

Very respectfully, your obedient servant,

A. H. BLAISDELL, *Assistant Engineer.*

Capt. H. M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

REPORT ON COMMERCE OF OSAGE RIVER DURING CALENDAR YEAR 1896.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, June 30, 1897.

SIR: I have the honor to submit the following report on the commerce of the Osage River during the calendar year 1896:

The same methods as are referred to for the Missouri River were employed in obtaining the statistics.

The extreme and unseasonable flood which occurred in the valley of the river in December, 1895, diminished the amount of the lumber trade for 1896, but still a comparatively large amount was rafted out.

The larger part of the steamboat trade was performed by the steamer *Frederick*, she being engaged solely on the Osage River. She made fourteen trips to Tuscumbia, 60 miles above the mouth, once going as far as Linn Creek, 109 miles; in all she made eighty-one trips.

The following table, giving the amount of freight carried, towed, and rafted, is a near approximation of the 1896 commerce:

TABLE 1.

Class.	Grain.	Live stock.	Wood and lumber.	Railroad ties.	Building material.	Sand and gravel.	Salt.	Produce.	Farm machinery and general merchandise.	Total.	Mile-tons.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	
Packets and miscellaneous boats	3,197.3	1,130.8	879.8	....	391.3	102	95.9	130.5	895.8	6,823.4	229,215
Rafts	......	......	1,750	37,720.2	......	......	......	......	......	39,470.2	3,293,060
Total	3,197.3	1,130.8	2,629.8	37,720.2	391.3	102	95.9	130.5	895.8	46,293.6	3,522,275

The following table gives the totals, in tons, of the different classes of freight carried for the series of years 1896–1890:

TABLE 2.

Articles.	1896.	1895.	1894.	1893.	1892.	1891.	1890.
Hay, grain, etc	3,197.3	3,203	3,061	3,081	1,547	4,035	2,658
Live stock	1,130.8	920	847	144	416	425	209
Lumber, logs, wood, and railroad ties	40,350	42,436	27,269	17,915	10,626	19,646	22,806
Sand and gravel	102	....	113	....	....	....	....
Salt	95.9	83	69	80	23	29	23
Farm machinery and general merchandise	895.8	780	1,016	703	237	256	377
Produce	130.5	122	136	135	80	67	5
Building materials	391.3	....	....	....	....	....	....
Total	46,293.6	47,544	32,511	22,058	12,929	24,458	26,083

Table 3 gives the comparative commerce expressed in mile-tons for the three years 1896–1894, this data having been secured only since the river has been in charge of the Missouri River Commission.

TABLE 3.

Class.	1896.	1895.	1894.
Packets and miscellaneous boats	229,215	197,574	211,353
Rafts	3,293,060	3,247,507	2,219,606
Total	3,522,275	3,445,081	2,430,959

The steamers engaged on the river during 1896 were as follows: *Annie Dell*, *Gasconade*, *Kingfisher*, *Mill Boy*, and *Peerless*, the custom-house measurements of which are given under the heading of the Missouri River.

Besides these steam vessels, barges propelled by manual labor, and the gasoline boat *Hermann* carried 248 tons of miscellaneous freight during the year.

Very respectfully, your obedient servant,

A. H. Blaisdell, *Assistant Engineer.*

Capt. H. M. Chittenden,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

REPORT ON COMMERCE OF GASCONADE RIVER DURING CALENDAR YEAR 1896.

Office Missouri River Commission,
St. Louis, June 30, 1897.

Sir: I have the honor to submit the following report on the commerce of the Gasconade River during the calendar year 1896:

The same method of obtaining the statistics was followed as are referred to under the heading of Missouri River commerce.

The steamboat trade was principally performed by the boats of the Hermann Ferry and Packet Company and by the steamer *Kingfisher*.

The latter made eight trips as high up as Vienna, 78 miles, but the larger amount of the trade was performed over an average distance of 34 miles above the mouth.

Most of the lumber came from the Big Piney Creek, 122 miles, and the railroad ties were rafted from an average distance of 82 miles.

The following table gives a close approximation to the amount of the 1896 commerce of the river, although in a few cases parties who are reported as having carried on a small amount of river business failed to respond to letters of inquiry:

Table 1.

Class.	Grain.	Live stock.	Wood and lumber.	Railroad ties.	Sand and gravel.	Salt.	Produce.	Farm machinery and general merchandise.	Total.	Mile-tons.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	
Packets and miscellaneous boats	2,650.9	843.3	285.6	....	4,500	416	187.9	1,031.3	9,915	212,398
Rafts	....	....	1,656.5	60,822.1	....	......	......	....	62,478.6	3,839,483
Total	2,650.9	843.3	1,942.1	60,822.1	4,500	416	187.9	1,031.3	72,393.6	4,051,881

The following table gives the totals, in tons, for the different classes of freight during the series of years 1896–1890:

Table 2.

Articles.	1896.	1895.	1894.	1893.	1892.	1891.	1890.
Hay, grain, etc	2,650.9	4,496	4,793	3,773	5,471	6,135	5,118
Live stock	843.3	1,366	1,076	741	739	957	766
Lumber, logs, wood, and railroad ties	62,764.2	64,986	89,086	62,020	69,721	77,195	86,349
Sand and gravel	4,500	3,600	8,100	....	....	....	....
Salt	416	328	128	329	281	602	482
Produce	187.9	191	186	196	182	527	319
Farm machinery and general merchandise	1,031.3	1,739	1,416	946	1,686	2,858	2,269
Barytes	....	....	440	470	1,200	2,775	1,710
Total	72,393.6	76,706	105,225	68,475	79,280	91,049	97,013

Table 3 gives the comparative commerce expressed in mile-tons for the three years 1896–1894, this data having been secured only since the river has been in charge of the Missouri River Commission.

Table 3.

Class.	1896.	1895.	1894.
Packets and miscellaneous boats	212,398	263,554	361,292
Rafts	3,839,483	2,941,509	4,169,429
Total	4,051,881	3,205,063	4,530,721

The steam vessels engaged in commerce on the river during 1896 were only five in number, viz, *Frederick*, *Edna*, *Urie*, *A. W. Ewing*, and *Harry*, the official measurements of which are given in the report on the commerce of Missouri River.

The gasoline boat *G. L. Geister*, of about 45 tons, did a small amount of the packet trade.

Very respectfully, your obedient servant,

A. H. BLAISDELL, *Assistant Engineer.*

Capt. H. M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

APPENDIX D.

REPORT ON STEAMBOAT WRECKS ON MISSOURI RIVER BY CAPT. H. M. CHITTENDEN, CORPS OF ENGINEERS.

MISSOURI RIVER COMMISSION, OFFICE OF THE SECRETARY,
St. Louis, Mo., June 30, 1897.

COLONEL: I have the honor to transmit herewith for incorporation in the Annual Report a list of steamboat wrecks which have occurred on the Missouri River from the opening of steamboat navigation to the present time. The preparation of this list, which received your verbal approval before it was begun, has entailed much more labor than was at first expected. The number of wrecks has been found to be greater than anticipated, and the deficient and conflicting data in many cases have involved considerable research to get at the correct facts.

In collecting this information a working list was first prepared by the aid of Capt. Joseph La Barge, probably the oldest living pilot on the Missouri River, with over sixty years' active experience, and Capt. E. H. McFarland of the snag boat *Charles R. Suter*. This list was then mailed to all surviving Missouri River pilots whose length of service was such as to give them some historical knowledge of the river, with a request for information under certain specified heads. This correspondence resulted in ten replies, more or less complete, from Capts. J. B. Clarke, Joseph Fecto, E. H. Gould, John P. Kaiser, William G. Lingo, Grant Marsh, W. R. Massie, James O'Neal, W. H. Sims, and George W. Vaughan.

The information in these several communications was collated on memorandum cards, one to each wreck, so as to bring all the data pertaining to each case into one group. From these cards the condensed descriptions have been prepared. Acknowledgments are due to those who have responded to the requests sent out as above described, and particularly to Capts. Joseph La Barge and William G. Lingo. The long acquaintance of the former with Missouri River navigation has supplied much information which would otherwise have been lost. Captain Lingo has rendered valuable assistance by searching the records of old St. Louis newspapers, the lists of steamboat disasters at the St. Louis Merchants' Exchange, and such publications relating to the subject as could be found in the city libraries.

The list thus compiled is believed to be very nearly correct. Its publication may elicit a few errors, and possibly some additions, and it may be desirable to revise it at a later period. Such revision, however, can effect only minor details, for in essential features the list, in its present form, may be considered complete.

ANALYSIS OF LIST.

The total number of wrecks embraced in the list is 295,* distributed according to cause of wreck as follows:

Cause of wreck.	Number of boats wrecked.	Cause of wreck.	Number of boats wrecked.
Snags	193	Storm and wind	2
Fire	25	Collisions	1
Ice	26	Overloading	1
Rocks	11	Swamping in violent eddy	1
Bridges	10	Unknown	14
Explosion of boiler	6	Total	295
Sand bars and falling river	4		
Ran into the bank	1		

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* This includes 6 boats wrecked twice and finally lost, 1 boat wrecked three times and finally lost, 12 boats wrecked once and saved, and 1 boat wrecked twice and saved. This reduces the actual number of boats lost to 273.

From the above table it is seen that the great menace to the safety of navigation on the Missouri River has heretofore been the snags and rocks which abound in its bed, the total number of disasters from these two causes being 204. This fact fully justifies the maintenance of the elaborate plant now employed in clearing the lower river of these obstructions. The active service of the snag boat may be said to have removed largely the dangers to steamboat navigation from snags, and ought to have a favorable influence on the insurance rates for Missouri River boats.

The next most important cause of wrecks has been fire. In the majority of instances disasters from this cause have been due to sheer carelessness, as in the cases of the *Butte* and *Chippewa*. The carrying of candles into the hold, the overturning of lights, and other similar negligences, explain many of these disasters. Danger from this source is now greatly diminished by the use of electricity, which obviates almost entirely the necessity of carrying lights.

Ice has also been one of the principal causes of steamboat wrecks, and this danger can not be said to have diminished in recent years. Owing to the decline of steamboat navigation, suitable ways for hauling out boats have fallen into decay more rapidly than they have been repaired or replaced by new ones; and no ice harbors to speak of have been constructed on the river.

Accidents from steamboat explosions were very common, and of appalling fatality, in the early history of steamboat navigation. In Lloyds' Steamboat Disasters, published in 1856, out of a total of 213 wrecks given, 124 were from this cause, and of the 2,035 lives lost, the greater part were on boats so wrecked. This record is probably not to be relied upon strictly, for the sensational tenor of the work indicates that especial attention was devoted to the more terrible disasters, and other early records do not corroborate its statements. But, after making due allowance for exaggeration, it is nevertheless true that in the early steamboating days boiler explosions were both frequent and terribly destructive of life and property. The improvements in the material and construction of boilers, the better arrangement for supplying feed water, the application of various safety appliances, and, above all, the enforcement of Government laws and regulations which provide for the inspection and tests of materials and workmanship in marine boilers during construction, for annual inspection of the vessel after it is built, and for the licensing of the chief officers in the marine service, have largely removed this cause of steamboat disasters.

The other causes of wrecks, except bridges, are mostly accidental and require no comment.

The only danger to navigation on the river which has increased in recent years is the bridges which span the stream. It is probably true that at present these bridges are more dreaded by the pilot than all other obstructions put together. This unfavorable condition arises from two causes: (1) injudicious location of the bridges in some instances; and (2), in all, the ever-changing character of the channel of the river. With a good navigable depth and satisfactory approaches one year, there is no assurance that they will be there one or two years later. The channel may shift, and has done so, from a draw to a fixed span, thus cutting off the passage entirely. It would seem that a judicious improvement of the navigation of the Missouri River should require the permanent and fixed control of the channel of the stream for a sufficient distance above and below every bridge to allow of a safe approach for vessels.

A list of bridges over the Missouri River from the mouth to the head of navigation, prepared by Mr. A. H. Blaisdell, United States assistant engineer, with some comments and suggestions relating thereto, accompanies this report.

Very respectfully, your obedient servant,

HIRAM M. CHITTENDEN,
Captain of Engineers, U. S. A.,
Secretary Missouri River Commission.

Lieut. Col. AMOS STICKNEY,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time.

[Compiled under direction of Capt. Hiram M. Chittenden, Corps of Engineers, secretary Missouri River Commission.]

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Abner O'Neal	Stern-wheel; 160 by 28 feet.	Carrying wheat to Bismarck from points above.	July 19, 1892	Painted Woods, N. Dak.	Shore rocks.	Boat valued at $12,000.
Admiral	Side-wheel; 169 by 26 feet	St. Louis to Omaha and Sioux City. Owned and commanded by Capt. William Baker.	Oct., 1858	Head of Weston Island.	Snag	Sank in shallow water. Very little cargo and no lives lost. She was afterwards raised and run many years successfully.
Alert	Side-wheel	Irregular trade	1840	Alert Bend, opposite Fishers Landing, Mo.	do	
Alice Grey	Stern-wheel; small freight steamer.	Missouri River trade	Dec. 16, 1875	Head of Paynes Island, 5 miles below Rocheport, Mo.	Boiler explosion.	
Algoma	Side-wheel	Irregular trade	1849	1 mile below Lexington, Mo.	Rocks	Cargo mostly saved. No lives lost.
Amanda	Side-wheel; 140 tons.	Missouri River trade	Nov. 17, 1867	Peters Landing, Ia., above Omaha.	Fire	
Amazon	Side-wheel; 250 by 32 feet.	St. Louis and Council Bluffs. Built and owned by Capt. H. Hazlett, who sold her to Ménard Chouteau shortly before she sank.	1856	3 miles above mouth Missouri River.	Snag	
Amelia Poe	Stern-wheel; 175 by 30 feet; 327 tons.	St. Louis and Fort Benton. Owned by Capt. William Poe and named for his wife; Capt. Thomas Townsend, master, at time of wreck.	May 23, 1868	Near Little Porcupine Creek.	do	Boat a total loss. Most of the cargo was saved, but no lives lost. The merchandise was mostly taken to Helena, where it was claimed by the insurance companies. Some machinery, intended for a quartz mill, was taken out and put on the bank, where remnants of it remain to this day.
Andrew S. Bennett	Stern-wheel	Ferryboat at Sioux City, Iowa.	About 1888	Sioux City, Iowa	Ice	Built by Capt. Grant Marsh at Sioux City. Named after Capt. Andrew S. Bennett, of the Fifth Infantry, who was killed in action by the Indians.
Annie Lee	Stern-wheel; small steamer.	Vicinity of Boonville, Mo.	Nov. 11, 1881	Griffiths Landing, Mo., Euphrasie Bend.	Snag	No lives lost.
Antelope	Side-wheel; 180 by 32 feet; 326 tons.	Fort Benton trade. Owned by W. R. Massie.	Apr. 12, 1869	5 miles below Bonhomme Island (upper island).	Fire	The chambermaid of the boat was burned on her. Boat valued at $20,000; cargo at $38,000. Boat and cargo a total loss.
Anthony Wayne	Side-wheel	St. Louis and St. Joseph	Mar. 25, 1851	8 miles above Liberty Landing, Mo.	Snag	
Arabia	do	St. Louis and St. Joseph. Owned by Capt. Bill Terrell, who bought her from Capt. John Shaw.	Aug. 10, 1856	1½ miles below Parkville, Mo.	do	Loaded with cargo of merchandise valued at $16,000.

Arabian	Stern-wheel	Missouri River trade	May 4, 1868	Atchison, Kans	do	
Argonaut	do	An Ohio River boat in Missouri River irregularly.	About 1865	Mouth Missouri River	do	
Asa Wilgus	Side-wheel	St. Louis and St. Joseph. Ash Hopkins, owner; W. R. Massie, pilot.	About 1860	7 miles below Hermann, Mo.	do	
Assinniboine	Side-wheel; single engine.	Fur trade. Owned by American Fur Co.; John Carlisle, master.	June 1, 1835	Head of Sibley Island, N. Dak.	Fire	The boat had got aground when the river was falling rapidly and was soon left high and dry. A flat boat was ordered built, with which the cargo was to be floated down the river, and the boat was to be left until a rise in the river should float her. But before the cargo was removed the boat took fire from a stovepipe in the cabin, and, with its cargo, was entirely destroyed. The cargo was from the mouth of the Yellowstone, and consisted of 1,185 packs of peltries, with a large collection of Indian relics. There were four live buffaloes on board, which were run into the river and reached the shore by swimming.
Astoria	Side-wheel	St. Louis and St. Joseph	1840	Opposite mouth Blue River, in Astoria Chute (Missouri).	Snag	
Australia	Side-wheel, about 200 ft. long; 289 tons.	do	June 10, 1855	Euphrasie Bend	do	The boat was raised and subsequently lost by fire, Apr. 1, 1858, while lying in port at St. Louis.
Balloon	Side-wheel	St. Louis and St. Joseph; John McClay, owner and master.	1848	Sank below Augusta, Mo.	do	Cargo and boat total loss; no lives lost.
Banner State	Side-wheel, 250 tons; 2 engines.	St. Louis and St. Joseph; Joseph S. Nansen, master.	Apr. 11, 1855	Brick House Bend	do	A very popular boat in her day.
Bachelor	Stern-wheel	Upper Missouri River	Nov., 1869	Fort Pierre, S. Dak	Rocks	
Bedford	Side-wheel; single engine.	St. Louis and St. Joseph	Apr. 25, 1840	Mouth Missouri River	Snag	Boat struck a snag and knocked large hole in her bottom and commenced filling immediately; sank in about a minute to her hurricane deck. A dreadful storm of rain was raging at the time, and the night was very dark. A number of persons were lost. One report gives the number as 12 or 14. One of the male passengers lost his trunk, in which there was $6,000 in specie. Boat and cargo total loss.
Behan	Stern-wheel; 160 by 33 feet.	Bismarck trade and points above.	Mar. 24, 1884	Bismarck, N. Dak	Ice	Boat valued at $10,000; insured for $3,000.
Belle of Jefferson	Stern-wheel	Irregular trade	July 13, 1875	Head of Osage Chute.	Snag	Boat and cargo total loss. No lives lost.
Ben Johnson	Side-wheel; large boat.	St. Louis and Omaha. Owned by Capt. Ben Johnson.	About 1870	4 or 5 miles below Brownsville, Nebr.	do	This boat was raised; was subsequently lost by fire at St. Louis. She took the United States Commission to Fort Sully in 1866 to treat with the Sioux Indians, being chartered by Capt. Joseph La Barge for the Commission's trip at $300 per day.
Bennett	Side-wheel	Wrecking boat	1852	Bend above mouth Kaw River.	do	Wrecked on her way up to raise the steamer Dacotah, which had sunk at Peru Cut-off.

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Benton	Stern-wheel; 246 tons.	St. Louis and Fort Benton. Durfee & Peck, fur traders, owners. Capt. Frank Dozier, master; W. G. Lingo and T. Lemon, pilots.	May 19, 1869	Benton Bend, 8 miles above De Soto, Nebr.	Snag	Boat lost; very little cargo saved. This boat had previously been injured by collision with the St. Charles Bridge.
Benton (No. 2)	Stern-wheel; 394 tons.	Upper Missouri River. James P. Boland and T. B. Sims, owners; James P. Boland, master.	July 18, 1897	Sioux City, Iowa	Bridge	This boat was first wrecked Sept. 15, 1889, by striking a snag 5 miles above Washington, Mo. She was raised and repaired and entered the trade again. On July 31, 1895, when engaged in the lower river trade, the tiller rope broke and the boat became unmanageable and struck a snag and sank opposite Arrowrock, Mo.; 600 sacks wheat were lost. No lives were lost. Boat was raised and repaired and entered the trade again. In the spring of 1897 she entered the upper river trade. On July 18, 1897, she was on down trip and commenced signaling when 4 miles up the river for the Sioux City, Iowa, Combination Bridge drawspan to be opened. The bridge attendants, however, failed to open the bridge. The boat's crew then tried to prevent the boat from being wrecked on the bridge, but in backing off a hole was knocked in her hull by some submerged piling. The boat rapidly filled with water and became unmanageable, and was carried by the swift current against the pivot pier and and drawspan, knocking all her upper works down. Boat a total wreck; was valued at $8,000. No lives lost.
Ben West	Side-wheel	Missouri River trade	Aug. 10, 1855	Near Washington, Mo.	do	Loaded with lumber for Lexington, Mo.; boat valued at $5,000. Boat a total loss. No lives lost.
Bertha	Stern-wheel; about 180 by 28 feet; 175 tons.	Wood business	June 25, 1873	St. Joseph, Mo.	Bridge	
Bertrand	Stern-wheel; 160 by 30 feet.	St. Louis and Fort Benton. Owned by Capt. James Yores.	1865	Bertrand Bend, at Portage La Force, Nebr.	Snag	Boat and cargo total loss. Latter consisted in part of a large amount of quicksilver. No lives lost.
Big Hatchie	Stern-wheel	Missouri River trade	July 25, 1845	Hermann, Mo.	Boiler explosion.	Many persons killed and wounded. Boat does not seem to have been lost.
Big Horn	Stern-wheel; 178 by 31 feet.	Bismarck and Fort Benton.	May 8, 1883	10 miles below Poplar River.	Snag	Boat and cargo total loss. No lives lost.
Bird, A. C.	Stern-wheel; about 120 feet long.	St. Louis and Kansas City.	Oct. 15, 1880	1 mile above Liberty Landing, Mo.	do	Boat and cargo total loss. No lives lost.

Bishop	Stern-wheel; small steamer.	Missouri River trade	July 15, 1867	Head of Peru Cut-off	Swamped	Boat was loaded with corn. In coming out of the Old River she struck the strong current in the new cut off just formed and was capsized. Andy Gouff, the mate, was lost.
Black Hawk	Side-wheel	Kansas City and Leavenworth. Built by Silas Haite, of Keokuk.	1862	Mouth of Bee Creek, 2 miles below Weston, Mo.	Snag	Boat and cargo total loss. No lives lost.
Black Hills	Stern-wheel	Bismarck and Fort Benton. Dr. W. A. Burleigh, owner.	Mar. 29, 1884	Bismarck, N. Dak.	Ice	
Boonville	Side-wheel, single engine.	Missouri River trade	1838	Bend above Kaw River	Snag	Loaded with corn for Government fort at Fort Leavenworth. Boat and cargo total loss. No lives lost.
Boreas (No. 2)	Side-wheel, 300 tons; 2 engines.	Missouri River trade. Built by Fithian & Barnard in 1845 or 1846.	1846	Hermann, Mo.	Fire	Large amount of silver bullion and Mexican money on board. Boat supposed to have been set on fire and money stolen. Boat and cargo total loss. No lives lost.
Bowling Green	Side-wheel; single engine; about 225 by 33 feet; 250 tons.	Missouri River trade. Built and owned by John J. Roe.	Dec. 12, 1842	Head of Osage Chute	Rocks	The boat was a total loss except the engines, which were taken off. No lives lost. The break, where the wreck lies, still shows plainly just below the upper end of Osage Chute.
Bridgeport	Stern-wheel; 250 tons.	Missouri River trade	June 2, 1868	1½ miles below Dakota City, Nebr.	Snag	Boat and cargo total loss. No lives lost.
Bright Light	Stern-wheel; about 250 feet long.	St. Louis and Kansas City. Owned by Capt. Dave Silver.	June 30, 1888	Boonville Bridge	Bridge	Boat struck the Boonville Bridge, drifted downstream to head of Boon Island, and during the following fall and winter the water left her high and dry. Later the machinery was taken off, and the hull repaired and afterwards brought to St. Louis, where it was used as a barge by Hy. Leighe. The boat was valued at $25,000 and was considered a total loss. The wreck led to a long lawsuit with the railroad company.
Butte	Stern-wheel	Missouri River trade. McGarrah & Powers, owners.	July 13, 1883	12 miles above Old Fort Peck, Mont.	Fire	Boat valued at $13,000; cargo at $110,000. Boat and cargo total loss. No lives lost.
Camden	Side-wheel	Missouri River trade	1839	Pattons Point	Snag	
Car of Commerce	Side-wheel; single engine; 250 tons.	St. Louis to Independence, Arrow Rock, Boonville, and Fort Leavenworth. Captain Reed, master.	May 8, 1832	Musics Ferry, Mo.	do	On passage from Chariton to St. Louis was snagged. A part of her cargo and all of her furniture was saved.
Carrie	Stern-wheel; 287 tons.	Missouri River trade. Bill Kountz, owner.	Aug. 14, 1868	At point 2 miles above Indian Mission, Nebr.	do	Bound for Fort Benton. Boat and cargo total loss. Boat valued at $20,000. No lives lost.
Carrier	Side-wheel; 215 by 33 feet, 250 tons.	Regular Missouri River packet. Ed. McPherson, owner and master.	Oct. 12, 1858	Head of Penns Bend	do	Sank in 5 feet of water. She was loaded with groceries and dry goods, having on board 250 tons. Boat valued at $30,000; was total loss. No lives lost.
Carroll (No. 1)	Stern-wheel	Missouri River trade	1840	Brunswick, Mo., mouth of Grand River.	do	
Carroll (No. 2)	do	Yankton and Fort Pierre. Owned by Dr. W. A. Burleigh.	Apr. 19, 1877	50 miles above Fort Randall. Aubuchons' wood yard.	Fire	Burned to water's edge. Boat and cargo total loss; no insurance. No lives lost.

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Carroll, C. C.	Stern-wheel; 571 tons.	St. Louis and Kansas City. Partially owned and commanded by Capt. Dave Silver.	Sept. 15, 1886	Chapmans Landing, Mo.	Snag	
Chariton	Side-wheel; single engine; about 160 by 25 feet.	St. Louis to Liberty and Independence. Capt. Matthew Ramsey, master.	Oct., 1836	Below Glasgow, in Euphrasie Bend.	do	This boat first sank at the mouth of the Gasconade River, by striking on the rocks. She was afterwards raised and brought to St. Louis, and was repaired. She entered the trade again, and was sunk on her way to Independence. Some of the cargo was saved, as well as a large sum of money belonging to the United States Government.
Chambers, Col. A. B. (No. 1).	Side-wheel; 2 engines.	St. Louis and St. Joseph	Mar., 1856	1 mile above Atchison, Kans.	do	Saved fixtures and furniture. No lives lost.
Chambers, A. B. (No. 2).	Side-wheel; 225 by 33 feet; 417 tons.	St. Louis and St. Joseph. Built by Capt. Jim Gormley; Capt. G. W. Bowman, master.	Sept. 24, 1860	Just above the mouth of Missouri River.	do	She was a fine boat; sank on her first trip; was a total loss; no lives were lost. The first Chambers was called the Col. A. B. Chambers, the second the A. B. Chambers; both named after the editor of the Missouri Republican.
Champion	Side-wheel	Missouri River trade	1863 or 1864	Opposite Portland Island.	do	
Chian	do	do	Mar. 20, 1836	Euphrasie Bend	do	Sank on down trip to St. Louis, 20 miles below the Chariton, and was almost a total loss, some parts of the engine only being saved. Boat insured for $7,500. No lives lost.
Chippewa	Stern-wheel; 160 by 30 feet.	St. Louis and Fort Benton; Mountain trade. Owned by American Fur Company; W. H. Humphreys, master.	May, 1861	15 miles below Poplar River.	Fire	The fire was discovered at supper time on a Sunday evening. The boat was immediately run ashore, the passengers put off, and she was then turned adrift to avoid danger from explosion of powder on board. The boat drifted across the river and nearly a mile down, and, just as fire had reached the water's edge blew up. There were many passengers bound for the mountains, including some English people. Boat and cargo a total loss. No lives lost. This disaster was caused by some deck hands, who entered the hold with a candle to tap some whisky barrels. It is presumed that they became intoxicated, tipped over the candle, and thus started the fire.
Clara	Side-wheel; 225 by 34, 320 tons.	St. Louis and Kansas City Star Line Packet Co., owners; Captain Ryder, master.	May 24, 1870	½ mile above Ousleys Landing, Mo.	Snag	The Clara was a fine, large, and fast boat. Had on board large cargo of hemp, tobacco, corn, and wheat.
Clarke H. Green	Center-wheel.	Ferryboat	Jan. 28, 1858	6 miles above Cambridge, Mo.	do	Boat sank while carrying cargo of flour for the Glasgow Milling Co. from Glasgow to Leavenworth.

Clendenin, J. M.	Side-wheel; 200 by 32 feet; 350 tons.	St. Louis, Glasgow, and Brunswick. Capt. Henry W. Smith, master. He was also one of the owners. Capt. Ed. Herndon, clerk.	Nov., 1858	Bates's wood yard, Mo.	do	Captain Smith was one of the founders of the Memphis Packet Co. and also of the well-known Anchor Line of steamers. Boat and cargo a total loss. No lives lost.
Coleman	Stern-wheel; small boat.	Irregular trade, Boonville and up river, and also Lamine River trade.	1882	Diana Bend, 3 miles above Rocheport, Mo.	Boiler explosion.	
Col. McCloud	Stern-wheel; 160 by 26 feet.	St. Louis and Fort Benton. Owned and built by I. G. Baker & Co., of Fort Benton, Mont.	Nov. 18, 1879	Bismarck, N. Dak.	Collision.	The Col. McCloud was built for the purpose of doing low-water work on the Upper Missouri River, but was a failure so far as being a light-draft boat. After the close of navigation in 1879 she and the steamer Butte, of the Powers Line, were to be repaired on the ways at Bismarck. The Butte was pulled out one evening, and the Col. McCloud was dropped into the foot of the ways, with the intention of pulling her out the next morning. After the men had quit work a storm came up and blew the Butte loose, allowing her to slide down the ways, and striking the McCloud with such force that she (the McCloud) was sunk at the foot of the ways, and proved a total loss. A long lawsuit ensued between the owners of the boats.
Columbian	Side-wheel; 250 by 38 feet; 350 tons.	St. Louis and Omaha. Capt. A. Barnes, master.	June 23, 1870	Head of Brunswick Island.	Snag	Built by Captain Wharton, at Millers Landing (New Haven), Mo., during the war, of Missouri burr oak, of good strong timber, but the lumber was not long enough. The boat leaked a great deal. She was one of the boats that made up the original St. Louis and Omaha Packet Company's line of steamers.
Columbiana		Missouri River trade	Sept. 27, 1845	Lexington Bar	Unknown	Boat was insured for $2,100.
Commerce	Side-wheel; small boat.	do	1855	Wolfs Bend	Snag	Sunk on first trip.
Cora (No. 1)	Side-wheel	Weston and St. Joseph. Capt. Frank Dozier, master.	Apr. 17, 1851	Howards Bend	do	Boat and cargo a total loss. No lives lost.
Cora (No. 2)	Stern-wheel	Missouri River trade	1865	30 miles above Omaha, near Calhoun, Nebr.	Unknown	
Cora (No. 3)	Side-wheel; 360 tons.	St. Louis and Fort Benton. Capt. Joe Kinney, of Boonville, Mo., owner; Capt. Ed. Baldwin, pilot.	Aug. 13, 1869	Bellefontaine Bluffs	Snag	This boat's engines came out of the previous Cora. Her wreck caused Cora Island to form.
Corvette	Side-wheel; about 180 feet long.	Missouri River trade	1842	12 miles below Eureka Landing, Mo.	do	Boat sunk up to her skylights. Part of the cabin furniture was saved; cargo, total loss. No lives lost.
Crawford, T. L.	Side-wheel	do	1857	Hardeman's Orchard, opposite mouth Lamine River.	do	
Dacotah (No. 1)	Side-wheel; about 300 tons.	do	1851	13 miles above Peru	do	

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Dacotah (No. 2)	Stern-wheel; about 250 by 40 feet; 956 tons.	St. Louis and Kansas City	Sept. 17, 1884	Near Providence, Mo.	Snag	Was raised, towed to New Orleans, and dismantled. Her machinery is now on the steamer Imperial, in the New Orleans-Red River trade.
Dallas	Stern-wheel; small boat.	Missouri River trade	Sometime in the seventies.	Morgans Island	do	
Damsel	Stern-wheel	Circus boat. Charles Davis, pilot.	1876	Head of Onawa Bend	do	Had on board a circus company. Capt. Joseph La Barge came along on the John M. Chambers and took off the passengers.
Dan Converse	do	Missouri River trade	Nov. 15, 1858	10 miles above St. Joseph, Mo.	do	An old boat, valued at $3,000. Boat and cargo a total loss. No lives lost.
Daniel G. Taylor	Side-wheel; about 240 by 38 feet; 543 tons.	Mountain trade	July 5, 1856	3 miles below Rocheport; head of Paynes Island.	do	Was afterwards raised and worn out on the Lower Mississippi. She was a peculiar looking boat, having side wheels, but clear back at the stern. Named for a mayor of St. Louis, Mo.
Dart	Side-wheel; single engine.	Missouri River trade. Partially owned and commanded by Capt. John Cleveland.	1888	1 mile below Glasgow, Mo.	Rocks	
Dells	Stern-wheel	Missouri River trade	Oct. 26, 1878	Above Arago, Nebr.	Snag and explosion.	Struck snag and exploded her boilers and sank. Boat and cargo a total loss. No insurance. 2 lives lost.
Dew Drop	Stern-wheel; 148 tons.	do	June, 1860	Mouth of Osage River	Fire	
Delaware	Side-wheel	do	1857	Smiths Bar, Missouri.	Snag	
Denver (No. 1)	Side-wheel; 225 by 33 feet; 800 tons.	St. Joseph and Omaha. Owned by the Hannibal and St. Joseph R. R. Co. John Waddell, master.	May 16, 1867	St. Joseph, Mo.	Fire	Named for the first governor of Colorado. The wreck was afterwards rebuilt into the Denver No. 2. The Denver No. 1 burnt while lying at the wharf at St. Joseph, Mo.
Denver (No. 2)	Center-wheel	St. Joseph and Omaha, and ferrying.	Mar. 18, 1880	Opposite Fort Lincoln, N. Dak.	Ice	Built out of the wreck of the Denver No. 1.
Diana	Side-wheel	Missouri River trade. Owned by the American Fur Co. Capt. John Shallcross, master.	Oct., 1836	Diana Bend, 2¼ miles above Rocheport, Mo.	Snag	Built for the Cincinnati and Louisville Packet Company by Capt. Joe Swagers, one of the founders of above line. The steamer Diana was wrecked twice; the first time March, 1836, when she was bound for Council Bluffs, by striking a snag near Lexington. Her cargo was put ashore, but high water carried most of it off. The boat was temporarily repaired, brought to St. Louis and fixed up. She was next wrecked by striking a snag 2¼ miles above Rocheport, in what is now known as Diana Bend. Part of the cargo was saved. There was some expectation that the boat would be raised, but she was abandoned.

Don Cameron, J.	Stern-wheel	Government transport	May 17, 1877	Omaha and Winnebago Agency.	do	This boat was built by the United States Government for the Yellowstone River. She was transporting baggage and private property for the Fifth Infantry, from Fort Leavenworth to Fort Keogh, on the Yellowstone River, and sank on her first trip. No Missouri River pilot was on the boat. The boat was being steered by an officer. Boat and cargo a total loss. Several lawsuits grew out of this disaster. No lives lost.
Dugan, R. W.	Stern-wheel; 160 by 32 feet.	Missouri River trade. Capt. Joe Kinney, sr., owner. Capt. Joe Kenney, jr., master.	Oct. 21, 1878	2 miles below Dewitt, Mo.	do	Boat and cargo total loss. No lives lost.
Duncan Carter	Side-wheel; 221 by 33 feet.	Missouri River trade	Aug. 28, 1858	Augusta Bend	do	Sank on down trip from Weston to St. Louis, in 12 feet of water. Boat and cargo a total loss. She was 2 years old and was valued at $44,000.
Durfee, E. H.	Stern-wheel; 175 by 36 feet.	St. Louis and Kansas City	May 28, 1881	Mouth of Gasconade River.	Overloaded	This boat was named for one of the members of the firm of Durfee & Peck, fur traders. She was on a down trip and was fully loaded, but, on arrival at Portland, 8 miles above the Gasconade, she took on a large amount of wheat. She commenced sinking soon after swinging into the stream and went down at the mouth of the Gasconade River in deep water. Boat and cargo a total loss. Boat was valued at $18,000. No lives lost.
Durock	Side-wheel	Missouri River trade; John McCloy, master.	1852	St. Charles Bend	Snag	
Eagle	Stern-wheel; 125 by 25 feet.	Ferryboat	Feb. 27, 1897	Lexington, Mo.	Burnt	A gasoline stove exploded and set boat on fire. Boat was a total loss. Wreck removed by U. S. snag boat C. R. Suter, June 16, 1897.
Eaton, N. J.	Side-wheel	Glasgow packet	Apr. 9, 1856	Augusta Bend	Snag	Wrecked on her first trip up the Missouri River. Boat a total loss. She was valued at $38,000. The deck load was saved, balance of cargo was lost.
Eclipse	Stern-wheel; 178 by 31 feet.	Fort Benton trade. I. G. Baker, owner.	Sept. 3, 1887	15 miles below Sioux City, Iowa.	do	Boat and cargo a total loss. No lives lost.
Edgar		Missouri River trade	Mar. 26, 1884	Near Omaha, Nebr.	Ice	Boat valued at $3,500; insured at $2,000.
Edna	Side-wheel	Glasgow packet	July 3, 1842	Green Island at the mouth of the Missouri River.	Boiler explosion.	Named for one of Captain McCord's daughters. The flues collapsed in both boilers and killed about 55 German emigrants.
Ella Kimbrough	Stern-wheel; 243 tons.	Missouri River trade. Capt. T. N. Kimbrough.	Sept. 20, 1884	St. Charles Chute	Snag	This boat was formerly the General Sherman, a United States steamer. She was bought from the Government by P. P. Manion, who sold her to Captain Kimbrough, who named her for his wife. When wrecked she had on board 3,000 sacks of wheat. Boat and cargo a total loss; cargo was insured for $8,000. No lives lost.
Elk	Side-wheel; small steamer, single engine.	Missouri River trade	1838	Massie's wood yard, 5 miles below Hermann, Mo.	do	Passengers taken off by Capt. Joseph La Barge on the steamer Kansas.

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
El Paso	Side-wheel; about 180 by 28 feet; about 267 tons.	Missouri River trade. Capt. Bill Terrell, owner; Capt. W. R. Massie, master.	Apr. 10, 1855	Foot of Franklins Island, just below Booneville at Whites Landing.	Snag	Boat and cargo a total loss. No lives lost.
Emigrant	Side-wheel	Glasgow packet. Capt. Bill Terrell, owner.	1859	Across from Doziers Landing above Port Royal.	Fire	Do.
Emilie (No. 1)	Side-wheel; two engines.	Glasgow packet. Captain Kaiser and P. Choteau, jr., & Co., owners.	1842	Emilie Bend	Snag	
Emilie (No. 2)	Side-wheel	Owned by Hannibal and St. Joseph R. R. Co., and did business in connection with the road.	1865	Atchison, Kans	Wind	Wrecked by wind at St. Joseph. Hull floated down the river and sank at Atchison. She was the first side-wheel steamer that landed at Fort Benton.
Emily (No. 3)	Stern-wheel; 130 by 21 feet.	U. S. engineer service	Spring, 1885	6 miles above Bismarck, N. Dak.	Ice	
Emilie La Barge	Side-wheel; 290 by 40 feet.	St. Louis and Kansas City. Capts. David Silver and George Keith, owners; Capt. George Keith, master.	June 2, 1874	Nashville Bend	Snag	
Emma	Stern-wheel; small boat.	Missouri River trade	Aug. 1, 1873	20 miles above Omaha, Nebr.	Storm	Was carrying wood.
Euphrasie	Side-wheel; single engine.	do	Sept. 17, 1840	4 miles below Glasgow, in Euphrasie Bend.	Snag	This boat was named for the wife of George Collier, esq. The boat's furniture was recovered and the engine was taken out and put in the steamer Oceana. She had on board 71 hogsheads of tobacco, 150 bales of rope and bagging. This wreck caused the Glasgow Marine Insurance Co. to go out of business. One shipper, Capt. W. D. Swinney, had over $14,000 of insurance on a shipment of tobacco.
Excel	Stern-wheel; 79 tons.	Osage River trade. Joe Fecto, pilot.	Mar. 23, 1856	Osage Chute	do	Boat valued at $5,000.
Express	Side-wheel	St. Louis and St. Joseph	June 15, 1855	Short distance below Leavenworth, at Spar Island.	do	An old boat valued at $5,500.
Far West	Stern-wheel; 190 by 33 feet.	St. Louis and Rocheport	Oct. 20, 1883	Mullanphys Island	do	This boat was used in the Custer expedition. She brought the wounded from Little Big Horn to Fort Lincoln, a distance of 920 miles, in 54 hours, and was commanded by Capt. Grant Marsh. She afterwards ran in the lower river trade, Capt. Al. Dodd, master.

Fearless	Stern-wheel tow boat; about 160 feet long.	St. Louis and Kansas City. Kansas City Barge Line, owners.	Aug. 26, 1882	Head of Bonhomme Island, Mo.	do	This was the first and last experimental trip of the Kansas City Barge Line. The Fearless was a large, heavy-draft Ohio or Lower Mississippi River tow-boat, not at all adapted to the Missouri River. She was on down trip with a tow of grain barges from Kansas City. Boat was valued at $20,000.
Fire Canoe	Stern-wheel; small boat, 160 by 30 feet.	Kansas River packet. Goodin Bros. Coal Co., owners.	Nov. 13, 1858	Mouth of Kaw River in Kaw Bend.	do	She was on her way to Leavenworth loaded with coal. She was a total loss. Boat was valued at $5,000. No lives lost.
Florence	Side-wheel; 200 feet long, 250 tons.	St. Louis and Sioux City. Capt. Jos. W. Throckmorton, master, and Frank La Barge, pilot, and owners.	1856	Port Williams, Kans.	do	
Fontennelle	Stern-wheel	Fort Benton trade. Capt. Albert Kountz, master.	Aug. 1868	Opposite Amazonia, Mo.	do	She was afterwards raised. In the spring of 1881 she was cut down by the ice at Yankton, S. Dak.
Gallatin	Stern-wheel; 140 by 30 feet.	Fort Benton trade	Apr. 16, 1868	Mouth of Little Sioux River.	do	
General Brady	Side-wheel	Missouri River trade. Capt. J. Gunsolis, master.	1843	Opposite Hermann, Mo	do	
General Custer	Stern-wheel	Missouri River trade. Capt. Wm. J. Kountz, owner.	1879	Between Winnebago Bar and Rush Bottom.	do	
General Grant	do	Mountain trade	Mar. 18, 1866	3 miles below Bellevue, Nebr.	Ice	Had 172 tons of freight on board for Fort Benton at time of wreck.
General McNeil	do	Missouri River trade	During the sixties.	Howards Bend	Snag	
General Meade	Stern-wheel; 190 by 30 feet; 171 tons.	St. Louis and Osage River. Capt. Archie Bryant, owner and master.	Aug. 25, 1888	Pelican Island	do	Wm. J. Kounts built and sold her to Capt. Archie Bryant. She was loaded with a cargo of 4,000 sacks of wheat. Boat and cargo a total loss. Boat insured for $4,000. No lives lost.
General Terry	Stern-wheel; 174 by 31 feet.	St. Louis and Omaha. Baker & Powers, owners.	June 10, 1888	Omaha, Nebr.	Bridge	Boat struck bridge at Omaha. She was loaded with troops. Boat and cargo a total loss. Boat was valued at $16,000 and cargo at $4,500. No lives lost.
General W. H. Ashley.	Side-wheel	Missouri River trade. Capt. Jas. Sweeney, owner and master.	1830	Femme Osage	Snag	
Geo. C. Wolf	Stern-wheel; 250 tons.	St. Louis and Kansas City. Capt. W. W. Crapster, master.	May 2, 1874	Bowling Green Bend, at Babbler's wood yard, Missouri.	do	
George Lee		Ferryboat	Feb. 14, 1883	Rocheport, Mo.	Ice	Boat and cargo a total loss. No lives lost.
George Spangler	Stern-wheel	Missouri River trade	Sept. 14, 1879	Alert Bend, 5 miles above Portland, at Barrys Landing, Mo.	Snag	
George Washington.	Side-wheel; single engine.	do	1826	Hardemans Orchard, opposite mouth Lamine River.	do	Loaded with Government stores for Fort Calhoun or Council Bluffs.
Glencoe	Side-wheel	Above Nebraska City, Nebr.	About 1837	Copelands Bend, 3 miles above Nebraska City.	do	

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Governor Allen	Side-wheel; towboat.	Towing in Missouri River	Mar. 15, 1877	Thomas, or Millers' Bend, at head of Millers Island.	Snag	
Goddin, A. C	Side-wheel	Glasgow trade. Capt. John La Barge, master.	Apr. 20, 1857	Bonhomme Island (Lower Island), Mo.	do	Boat and cargo a total loss. Boat valued at $20,000. No lives lost.
Gus. Linn	do	Missouri River trade. Capt. W. Beasley, owner and master.	1865	Henry Chattillon Bend.	do	Boat and cargo a total loss. No lives lost.
Haidee	do	Missouri River trade	1846	Charbonere Island	do	
Halcyon	do	Missouri River trade. Captain Shephard, master.	Nov. 14, 1834	do	do	On her way from St. Louis to Fort Leavenworth she was snagged and sank 5 or 6 miles below St. Charles in 8 or 10 feet of water, but the heavy deposits of sand peculiar to the Missouri prevented her being raised. Most of the freight was, it was understood, uninsured. No lives were lost.
Helena (No. 1)	Stern-wheel; 210 tons.	Missouri River trade. Powers Line, owner; Captain McGarrah, master.	Oct. 31, 1868	Upper Bonhomme Island.	Snag	Cargo in hold damaged, but deck freight was saved. Boat was raised.
Helena (No. 2)	Stern-wheel, 190 by 33 feet.	Missouri River trade, to Fort Benton. A. Bryan, owner.	1887	Lower Bonhomme Island, Mo.	do	A. Bryan purchased her from the Powers Line.
Hermann	Side-wheel	Missouri River trade; freight and passengers. Capt. Tom Baker, master.	1846	Opposite St. Charles Mo.	do	
Hesperian	do	Missouri River trade. Capt. F. B. Kercheval, owner and master.	1857	Two miles below Atchison, Kans.	do	
Hilman, F. F	Stern-wheel	Missouri River trade	In the eighties.	Miami Bend (in the bar).	do	
Hiram Wood (No. 1)	Stern-wheel; 100 by 22 feet.	Fort Benton trade. Dr. W. A. Burleigh, master.	Mar., 1870	Bijou Hills, Rosebud Landing.	do	Wreck bought by Capt. G. Marsh, who dismantled her and made a ferryboat out of her.
Hiram Wood (No. 2)	Side-wheel	Ferryboat	1880	Sioux City, Iowa	Unknown	This boat had cogwheel machinery. It was taken off the wreck and put into the A. S. Bennett.
Honduras	do	Missouri River trade	1858	Rivais Bend, above Doniphan.	Snag	Wreck afterwards raised.
Howard	do	do	1838	Auxvasse River	do	
Huron	Stern-wheel	Towboat	Oct. 24, 1871	St. Johns Island	Fire	
Ida Reese	Stern-wheel; 180 by 30 feet; 225 tons.	Fort Benton trade. Durfee & Peck, Indian traders, owners; Capt. John Gillam, master.	June 20, 1871	Near White River	Snag	Boat was loaded with valuable furs and robes, most of which were saved.
Ida Stockdale	Stern-wheel; 180 by 32 feet.	Fort Benton trade	Apr., 1871	Bismarck, N. Dak	Ice	Built at Pittsburg, Pa., by Capt. Grant Marsh.

Imperial	Stern-wheel; moderate size.	do	1867	Upper Bonhomme Island.	do	
Ione	Side-wheel; 250 tons; single engine.	Missouri River trade	1846	Mount Vernon, just above mouth Saline River.	Snag	
Island City	Stern-wheel; 140 by 30 feet.	Missouri River trade; freight and passengers. Capt. Alex. Lamont, master; Capt. John Gillam, pilot.	1864	Bend below Fort Buford, N. Dak.	Ice	
Jas. Lyons	Stern-wheel	Missouri River trade	In the eighties.	South side of lower Bonhomme Island.	Snag	
John Bell	Stern-wheel	Government boat	1861	Opposite foot of Howards Bend.	Rocks	Boat was loaded with supplies.
John Golong	Side-wheel; single engine.	Missouri River trade	1846	Malta Bend	Snag	
John Hancock	do	Missouri River trade	1840	Brick House Bend	do	
Jos. Kinney	Side-wheel; 230 feet long.	St. Louis and Kansas City	Apr. 13, 1882	Glasgow Bridge	Bridge	The Joe Kinney was first wrecked under the Boonville Bridge. She swung under the south span and scraped off pilot house, chimney, and texas. The second time she collided with the Kansas City Bridge and lost a wheel overboard. The last time the tiller rope broke and the boat became unmanageable and was wrecked on the Glasgow Bridge. Boat was valued at $27,000. She had on board 4,500 sacks of wheat, which was insured for $5,000. Boat and cargo a total loss. No lives lost.
Judith	Stern-wheel; 180 by 30 feet.	Fort Benton trade. Tennessee Packet Co., owners; Capt. John Gillam, pilot.	July 30, 1888	Pelican Island	Snag	
Julia	Side-wheel	Missouri River trade	About 1849	Bellefontaine Bend	do	
Kansas	do	St. Louis and Weston	Apr. 25, 1853	Kansas Bend, above Linden Landing.	do	Boat and cargo a total loss. No lives lost.
Kate Howard	Side-wheel; 504 tons.	Missouri River trade. Capt. Jos. S. Nansen, part owner and master; Capt. Joe Fecto, pilot.	Aug. 11, 1858	Osage Chute	do	Bound from St. Joseph to St. Louis with a cargo of hemp and tobacco, some of which was saved. Boat was valued at $40,000, and was regarded as a model boat in her day.
Kate Sweeney	Side-wheel; 328 tons.	Missouri River trade. Capt. P. M. Chouteau, owner; Capt. Joe Fecto, pilot.	Aug. 1, 1855	Kate Sweeney Bend, above Vermilion River.	do	This boat was named after the daughter of Capt. W. D. Sweeney, of Glasgow, Mo. She was a very successful and popular boat during her day. She was on her way from the mountains, and was loaded with furs. George Anderson and deck crew started to walk to Sioux City, but were killed by the Indians.
Katy P. Kounts	Stern-wheel	Missouri River trade	1878	Omaha and Winnebago Agency.	do	
Lacy, J. H.	Side-wheel	Hannibal and St. Joseph R. R. Co. packet.	Oct. 10, 1867	Charleston, Mo	do	Boat and cargo a total loss. Boat valued at $20,000. No lives lost.
Lady Grace	Stern-wheel	Missouri River trade; Capt. Dave Haney, master.	Jan. 8, 1870	Landing at Omaha, Nebr.	Fire	Boat valued at $12,000.

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Lady Lee	Stern-wheel	St. Louis and Kansas City. Owned by the Star Line; Capt. Bill Ball, master.	Mar. 29, 1882	Just below Fishing River.	Snag	The boat became unmanageable while backing out from a landing, on account of wind and water, and flanked against a snag. Boat and cargo a total loss; boat valued at $10,000. No lives lost.
Lancaster	Side-wheel	Missouri River trade	1865	Smiths Island	do	
Leadora	Stern-wheel; 180 by 32 feet.	Fort Benton trade	1867	Ponca Landing, Mo	Fire	Boat and 145 tons of freight a total loss.
Lexington	Side-wheel; 135 by 22 feet; 200 tons; single engine, 2 boilers.	St. Louis and Weston. Capt. William Littleton, master.	Sept., 1845	Frankfort, Mo	Snag	Wreck afterwards raised and brought to St. Louis.
Liberty	Side-wheel	Missouri River trade. Built, owned, and commanded by J. B. Moussette.	Oct. 24, 1881	Brick House Bend	do	
Lilly	Stern-wheel; 226 tons.	Missouri River trade	Oct. 24, 1868	Rush Bottom Bend, 1 bend below Rulo, Nebr.	do	Boat was loaded with Government stores. Boat and cargo a total loss; boat valued $20,000, cargo at $8,000. No lives lost.
Little Mail	Side-wheel; single engine.	do	Nov., 1845	Mount Vernon, Mo	do	Boat had on board cargo of hemp and hides. Boat, except the engine, which was taken off, and the cargo a total loss. No lives lost.
Little Missouri	Side-wheel	Weston trade. Capt. Bob. Wright, master.	About 1850	Frankfort, Mo	do	
Little Red	do	Missouri River trade	1840	Loutre Island, opposite Hermann, Mo.	do	Named after Senator D. Barton, of Missouri.
Livingston	Side-wheel; 120 by 20 feet.	Sioux City to Fort Benton	1868	Running Water	Ice	Afterwards raised, and in 1882 was dismantled and machinery put in the ferryboat Bennett.
Lizzie Campbell		Transfer boat	Mar. 6, 1883	Nebraska City, Nebr	do	Boat valued at $4,000.
Louisa	Side-wheel; 130 feet long; 250 tons.	St. Louis and Fort Leavenworth.	1864	South Point, Mo	Fire	Hemp in hold caught fire and boat was scuttled. Boat could not be raised, as river was rising very fast.
Louisville	Stern-wheel; 180 by 33 feet.	St. Louis and Weston. Capt. Abe Wolf, master.	Apr., 1864	Pratts Cut-off, or Louisville Bend.	Snag	
Louis F. Linn	Side-wheel	Missouri River packet trade. Capt. W. C. Jewett, master.	1848–49	Head of St. Charles Island.	do	
Low Water	Stern-wheel; small boat.	Missouri River trade	Nov. 27, 1857	Hills Landing, Mo	Unknown	Boat and cargo a total loss. Boat valued at $8,000. No lives lost.
Lynchburgh	Side-wheel	do	Mar. 27, 1842	In Pittmans Bend, mouth Femme Osage.	Snag	The Lynchburgh was a new boat, just brought out in February, 1842. She had on board 3,000 bushels of wheat. The passengers were brought down to St. Louis by the steamer Thomas.
Magenta	Side-wheel; 215 by 35 feet, 2 engines.	St. Louis and St. Joseph. Capt. F. M. Dozier, C. C. Chateau, Ben. Johnson, and Frank Constant, owners.	May, 1864	Bend below DeWitt, Mo.	do	She was a new boat. It was either her first or second trip. Boat and cargo a total loss. No lives lost.

Majors	Side-wheel	Missouri River trade.	Apr. 7, 1866	Near Brunswick, Mo.	Ran into the bank.	Formerly the U. S. steamer Mink. She ran into the bank above Brunswick, Mo., and stove in her head. She was repaired, and the Government sold her. Her name was changed to the Alex Majors. She was run in the Hannibal and St. Joseph R. R. Line from St. Joseph to Omaha. Was burned while lying at the wharf at St. Louis.
Malta	Side-wheel	Missouri River trade. Capt. Jos. W. Throckmorton, master.	Aug., 1841	Malta Bend, 2 miles above Laynesville, Mo.	Snag	Her principal freight was for the fur company. She sank in a little over a minute after striking snag, in 15 feet of water. Boat and cargo a total loss. No lives lost.
Mandan	do	Missouri River trade. Capt. Phil Hannon, master.		Mouth of Gasconade River.	do	
Mariner	Stern-wheel; 180 by 33 feet.	Missouri River trade	May 9, 1867	Onawa Bend, near Decatur, Nebr.	do	
Marion	Stern-wheel	Missouri River trade. Capt. Wm. Shanks, master.	1866	Assinniboine Landing	Sand bar	
Mars	Side-wheel; 180 by 34 feet.	Missouri River trade	May, 1865	Cogswell Landing, opposite mouth Fishing River.	Snag	
Mittie Stephens	Stern-wheel	Boonville and Rocheport. Capt. Henry McPherson, owner and master.	Aug. 7, 1884	Sibley, or Turkey, Island.	do	Boat left Adams Landing about breakfast time on the morning of Saturday, Aug. 7, 1884, loaded to the guards, and proceeded up river, bound for Boonville. After leaving the south shore and entering the chute at Sibley, or Turkey, Island, and while crowding an upper reef and headed for the bight of the bend on the inland shore, she ran away from the reef and down on the nest of snags. She struck about amidships and was a total wreck in a few minutes, and sank after floating into the inland shore, somewhere in the neighborhood of the towhead abreast of Sibley Island. Six lives reported lost. Boat was valued at $10,000. Cargo consisted of 3,500 sacks of wheat. Boat and cargo were insured.
Mary Bennett	Stern-wheel	Missouri River trade. Capt. Jim Clarke, master.	1869	Sioux City, Iowa	Ice	
Mary McDonald	Side-wheel; 436 tons.	St. Louis and Kansas City. Partly owned and commanded by Capt. George Keith; Capt. Henry Keith, pilot.	June 12, 1873	Gilhams Landing, Mo.	Fire	At the time of the accident the Mary McDonald was run as an independent packet. She was an excellent boat for the Missouri River. Her hull was full of hemp, which caught fire.
Mary McGee	Center-wheel	Missouri River trade	Apr. 6, 1877	Plattsmouth, Nebr.	Ice	Boat was valued at $5,000.
McDowell, A	Side-wheel	do	1850	Murdocks Bend	Snag	
Mettamora	Stern-wheel; small boat.	do	Sept. 27, 1875	Below Boonville, north side of Franklin Island.	do	Boat total loss. No freight on board. No lives lost.
Mattie Lee	Stern-wheel; 110 by 28 feet; 104 tons.	Vicinity Miami, Mo. D. Burruss, owner; Capt. Ed. Herndon, master.	1893–94	Murry Bend	Unknown	

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Minnie	Stern-wheel; moderate size.	Wood business		Below Leavenworth, Kans.	Snag	
Minnie Hermann	Stern-wheel; under medium size.	Sioux City and Labeau	Aug. 3, 1887	Five miles below Moreau, or Owl, River.	do	
Missouri	Side-wheel; single engine.	Missouri River trade. Capt. ——— Bennett, master.	1869	Fishing River Island	do	
Missouri Mail	Side-wheel	Missouri River trade. Owned by an Ohio River company.	1857–58	Just above Atchison, Kans.	Unknown	
Mollie Dozier	Side-wheel; 225 by 34 feet.	Missouri River trade. Capt. Fred Dozier, owner and master; Capt. George Keith, pilot.	Oct. 1, 1866	Chute opposite Chamois, Mo.	Snag	The boat struck a snag near Council Bluffs and sank, with 246 tons of freight on board. She was raised, and on her way down was snagged again.
Mollie Moore	Stern-wheel; 265 by 40 feet; 1,400 tons.	Fort Benton trade	1881	Chamberlain, S. Dak.	Rocks	Was an old boat. She caught on the bank on a falling river. She was the largest boat in the river.
Monongahela	Side-whell; small boat.	Missouri River trade	Feb. 11, 1870	Landing at Leavenworth, Kans.	Unknown	She was a condemned boat and was tied up to be wrecked and have her machinery, etc., removed, but sank before this was done.
Montana	Stern-wheel; large boat; 950 tons.	St. Louis and Kansas City	June 22, 1884	St. Charles Bridge	Bridge	Struck a pier of the St. Charles Bridge.
Nadine	Stern-wheel	Missouri River trade	Sept. 10, 1878	1 mile above mouth, Missouri River.	Snag	Boat and cargo a total loss. 3 lives lost.
Naomi	Side-wheel	do	1840	Mouth of Grand River (Brunswick).	do	
New Georgetown	do	St. Louis and Fort Leavenworth.	May 11, 1855	Bellefontaine Bluffs at Coldwater Creek.	do	Was bound for Fort Leavenworth loaded with Government stores. Boat and cargo a total loss. No lives lost.
New Lucy	Side-wheel; 225 by 33 feet; 416 tons.	St. Louis and St. Joseph	Nov. 25, 1857	Point opposite Dewitt, Mo.	Fire	A large, very fine and fast boat. She was regarded as one of the fastest boats in her day. She started to run against the Polar Star's time to St. Joseph. She beat the Star's time to Boonville, Mo., when she burned out a boiler. She burned while lying up in the ice.
New St. Paul	Side-wheel; 226 tons.	St. Louis and St. Joseph. Capt. James Bissell, master.	Aug. 19, 1857	1 mile below St. Auberts, Mo., at St. Auberts Island.	Snag	Had on board a cargo of groceries and merchandise. Boat valued at $25,000.

Nodaway	Side-wheel; 145 by 24 feet; 203 tons; 2 boilers; single engine.	Missouri River trade. Capt. J. J. Roe and Messrs. Blane, Tompkins & Barrit, owners; Capt. —— Cleghorn, master.		½ mile above Auxvasse River.	Unknown	
Nora	Stern-wheel	Missouri River trade	May 30, 1867	Below Decatur, in Pratts Cut-off or Louisville Bend.	Snag	
North Alabama	Stern-wheel; 160 by 32 feet.	Upper Missouri River trade. Capt. Jim McGarrah, pilot.	Oct. 27, 1870	Bow River Bend, above Vermilion.	do	
Nugget	Stern-wheel	Mountain trade	Apr. 22, 1866	Abreast Dacotah City, Nebr.	do	Boat and cargo a total loss; boat valued at $20,000.
Nuts				2 miles above Port Williams, Kans.	Unknown	
Nymph	Stern-wheel	Missouri River trade	Mar. 8, 1868	Chain of rocks at Sibley Bridge.	Rocks	
Oddfellow, S. B	do	do	Aug., 1850	Above Weston, Mo.	Snag	
Ogden, E. A	Side-wheel	Missouri River trade. Capt. Hamilton Lee, owner.	Sept., 1859	Claysville Bend	do	
Oglesby, J. H	Side-wheel; 225 by 35 feet.	Missouri River trade. Capt. E. T. Herndon, pilot.	Oct., 1859	Euphrasie Bend, 1½ miles below Bluffport, Mo.	do	
Onawa	Stern-wheel	Missouri River trade	1880	Onawa Bend	do	
Ontario	do	Mountain trade. Capt. Joe Fecto, pilot.	Sept. 22, 1866	Kansas Bend	do	Loaded with rails for Omaha; boat valued at $30,000.
Orion	do	Missouri River trade	1864	Eureka Landing, Mo.	do	
Osage	Side-wheel	do	1848		do	
Peninah	Stern-wheel; 180 by 30 feet; 287 tons.	do	Apr. 6, 1875	Sioux City, Iowa	Ice	
Peoria Belle	Side-wheel; 180 by 32 feet.	Upper Missouri River trade. Capt. Jim Clarke, master.	Oct., 1864	Arcrows's trading post 5 miles above Big Cheyenne River.	Grounded on bar.	Laid on bar until next spring, when the ice cut her down.
Peter Balen	Stern-wheel; large boat.	Mountain trade	July 22, 1869	Head Dauphin Rapids, Mont.	Fire	Boat and cargo a total loss; boat valued at $15,000. This boat made $80,000 in one trip to Fort Benton in 1866.
Petrel	Stern-wheel; small boat.	Missouri River trade	Jan. 6, 1888	South Point, mouth Dubois Creek.	Ice	Sunk by the ice coming out of the creek. Boat and cargo a total loss. No lives lost.
Pin Oak	do	do	July 29, 1896	Sandy Hook, Mo.	Snag	
Pirate	Side-wheel	do	1842	3 miles below Bellevue, Nebr.	do	
Plow Boy (No. 1)	Side-wheel; 275 tons.	do	1853	Left-hand bend above Providence, Mo.	do	
Plow Boy (No. 2)	Stern-wheel; small boat.	do	July 7, 1877	Arrow Rock, Mo.	Fire	Boat valued at $1,500. Insured for $600.
Plow Boy (No. 3)	do	do	Apr., 1897	Above Saline Point, between mouth of Grand River and Dewitt, Mo.	Snag	

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
Pocahontas (No. 1)	Side-wheel	Missouri River trade. Captain McCord, master.	Aug. 11, 1840	½ mile below Rock Bluff.	Snag	The Pocahontas was descending the river, when she struck a snag forward and tore a hole nearly to her stern. So great was the damage that she sank immediately, the water covering the engines. The boat was a total loss. She had on board a small lot of groceries, which were a total loss. The boat's money, books, and cabin furniture were saved.
Pocahontas (No. 2)	Side-wheel; 180 by 32 feet.	Fort Benton trade	Aug. 10, 1866	Pocahontas Island	do	Was engaged in carrying Indian supplies.
Pontiac	Side-wheel; 250 tons.	Missouri River trade. Capt. Tom Baker, master.	Apr. 10, 1852	Smiths Bend, above Doniphan.	do	Boat was loaded with whisky.
Portsmouth	Stern-wheel; 160 by 32 feet.	Missouri River trade	1861	Mouth of Bee Creek, 3 miles below Weston, Mo.	do	
Princess	Stern-wheel; 267 tons.	Upper Missouri River trade.	May 31, 1868	1 mile above Fire Creek, above Napoleon, Mo.	do	On her way to Fort Benton. Boat and cargo a total loss. Boat valued at $6,500. No lives lost.
Radnor	Side-wheel	Missouri River trade. Capt. J. T. Douglas, master.	1846	Just above mouth Lamine River.	do	Loaded principally with Government stores—about 60 tons—bound for Fort Leavenworth. Boat and cargo a total loss. Boat insured for $2,000. No lives lost.
Red Cloud	Stern-wheel; 225 by 34 feet.	Missouri River trade	July 11, 1882	Eighth point above Fort Peck, Mont., in Red Cloud Bend.	do	
Rialto	Stern-wheel	do	About 1864.	Mouth Bee Creek, 2 miles below Weston, Mo.	do	
Roanoke	do	do	1867	Pratts Cut-off or Louisville Bend.	do	
Robert Emmett	do	do	Last of the sixties.	St. Aubert Island	do	
Rose Bud	Stern-wheel; 180 by 31 feet.	Fort Benton trade	May 25, 1896	Bismarck, N. Dak.	Falling river	Sank while lying at the landing at the railroad warehouse at Bismarck, N. Dak. The river was falling and she caught on some piling.
Rowena	Side-wheel; 200 feet long.	St. Louis and St. Joseph	Mar. 14, 1850	Pens Bend, just above St. Charles, Mo.	Snag	She sank to the hurricane roof. Boat and cargo a total loss. No lives lost.
Roy Lynds	Stern-wheel; 130 by 30 feet.	Ferryboat	Feb. 5, 1897	Lexington, Mo.	Ice	An ice gorge that had formed in channel moved out and knocked large hole in her hull. Every effort was made to save her, but she sank in 12 feet of water at landing opposite Lexington, Mo. Boat was a total loss.
Sacramento	Side-wheel	Missouri River trade. Capt. Robt. Becker, master.	1849	Hardemans Orchard, opposite mouth Lamine River.	Snag	
Sallie West	Stern-wheel	Hannibal and St. Joseph R. R. Co. packet.	May 5, 1858	5 miles above Kickapoo, Kans.	do	She plied between Leavenworth, Kans., and St. Joseph, Mo., in the Hannibal and St. Joseph R. R. Co.

						Line. Boat was valued at $10,000. She had no freight on board at time of wreck.
Saluda	Side-wheel; 2 engines; 2 boilers; 179 feet by 26 feet 8 inches.	St. Louis and St. Joseph. Captain Belt, owner and master; Capt. Charles La Barge, pilot.	Apr. 9, 1852	Lexington, Mo.	Boiler explosion.	In 1850 the Saluda struck a snag and sank 5 miles below Rocheport. Her hull was dug out of the bar (that had presumably formed around her) some months afterwards, and brought to St. Louis, where she was rebuilt. She started for Council Bluffs with a load of Mormon emigrants, and had arrived at Lexington, when her boilers exploded, killing some 27 persons. Captain Belt, master, and Charles La Barge, pilot, were both killed. Peter Conrad and the office safe were blown 200 feet out on the bank. The surviving children of the passengers who were killed were adopted by citizens of Lexington, and some of them have grown up to be the foremost citizens of Lexington.
Sam Gaty	Side-wheel; 367 tons.	St. Louis and Leavenworth freight boat. Built and owned by Capt. John Baldwin; Capt. Frank Dozier, master.	June 27, 1867	Point opposite Arrow Rock, Mo.	Fire	She was a very light-draft and at the same time staunch boat, and was a success and a money-maker for many years. The boat struck a bluff bank, knocked her boilers down, took fire, and sank.
Seitz				Head of Onawa Bend	Unknown	
Senator	Stern-wheel; 120 by 26 feet.	Ferryboat	1888	Yankton, S. Dak.	Fire	
Seventy-Six	Side-wheel; 181 by 25½ feet; 2 engines.	Missouri River trade. Capt. John Gunsaullis, master.	1876	½ mile above Spring House, Mo.	Rocks	
Shamrock	Stern-wheel	Missouri River trade	1863	3 miles above mouth of the Missouri River.	Snag	
Shoal Water	Side-wheel	do	1828	Brick House Bend	do	
Sioux City	Side-wheel; 160 by 30 feet.	Mountain trade. Capt. Chas. Baker, owner.	Mar. 19, 1873	Fort Sully, S. Dak.	Ice	Cut to pieces by running ice.
Sonora	Side-wheel; 363 tons.	Missouri River trade. Capt. Bill Terrell, master.	Feb. 26, 1856	Portland, Mo.	do	Sunk by running ice. She had a valuable cargo on board. Boat valued at $10,000.
Spread Eagle	Side-wheel	Missouri River trade	1862–63	Pinckney Bend	Snag	
St. Anthony	do	Missouri River trade. Capt. Jim Gunsaullis, master.	Mar. 25, 1851	Opposite St. Charles, Mo.	Fire	
Statie Fisher	Center-wheel	Ferryboat	Feb. 1, 1888	Jefferson City, Mo.	Ice	Sunk by running ice. Was raised again. Sunk again by the ice at Jefferson City, Mo., during winter 1893.
St. Charles	Side-wheel; single engine.	Missouri River trade	July 21, 1836	Richmond Landing, Mo., opposite Lexington, Mo.	Fire	Loss estimated at $12,000; $3,000 insurance.
St. Louis Oak	Side-wheel	Missouri River trade. Capt. Jim Dozier, master.	1847	Head of Howards Bend.	Snag	
St. Luke	Side-wheel; 400 tons.	St. Louis and Kansas City. Owned by the Star Line.	May 2, 1875	½ mile below St. Charles Bridge.	Bridge	The St. Luke was built for the mountain trade by Capt. Joe Kinney, of Boonville, in 1866. She was on down trip when she struck the bridge. The river was very high. 9 lives reported lost.

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
St. Mary	Side-wheel; 300 tons.	Missouri River trade. Capt. Sam Cabell, owner.	Sept. 4, 1858	Hemmes Landing	Snag	She was bound from St. Joseph to Omaha, when she struck a snag and broke in two. Boat and cargo a total loss. Boat valued at $18,000. No lives lost.
Sully	Stern-wheel	Missouri River trade	Oct. 22, 1869	Smiths Bend, above Doniphan.	...do	
Sultan	Side-wheel	Missouri River trade. Capt. John McCloy, master.	1857	Sultan Bend, above Amazonia.	...do	
Sun Set	Stern-wheel	Missouri River trade	July 18, 1869	40 miles below Sioux City, Iowa.	...do	
Tacomy	Side-wheel	...do	1870	Fort Peck, Mont	Unknown	
Tammerlane	Side-wheel; 250 tons.	...do	1848	Foot of Wakendah Prairie.	Snag	
Tempest	Side-wheel	...do	About 1865	Bonhomme Island (Upper).	...do	
Tennessee	Stern-wheel	Fort Benton trade. Capt. Joe Wheeler, master.	Apr. 25, 1869	Right bank at head of Louisville Bend.	...do	Boat and cargo a total loss. Boat valued at $12,000. No lives lost.
Thos. Jefferson	Side-wheel	Government steamer	June, 1819	Near Cote Sans Dessein.	...do	This boat was one of the fleet of steamers in the celebrated Longs-Yellowstone expedition, the object of which was to ascertain whether the Missouri River was navigable by steamboats. It was the first steamboat wrecked in the Missouri River.
Timour (No. 2)	Side-wheel; 272 tons.	St. Louis and St. Joseph. Capt. Ed Dix, master	Aug. 26, 1854	3 miles below Jefferson City, on right bank, 1 mile above Moreau River.	Boiler explosion.	The boat was just leaving a wood yard when the explosion occurred. 30 or 40 persons were reported killed. The master, pilot, and clerk of the boat were killed. The office safe was thrown on top of the bluff by the force of the explosion. The wreck can be seen at low water.
Tom Morgan	Small boat	Ran about Leavenworth, Kans.	Feb. 5, 1866	....	Unknown	Boat was valued at $12,000.
Trenton	Side-wheel	Upper Missouri River trade	Apr. 3, 1883	Few miles below St. Charles, Mo.	Snag	
Tropic	Side-wheel; 225 by 33 feet; 300 tons.	Jefferson City and Leavenworth. Capt. Joe Nansen, master.	Oct. 14, 1857	½ mile below and opposite Waverly, Mo.	...do	This boat was one of the Lightning Line Packet Co.'s fleet; was old and of little value. Boat and cargo a total loss. 12 or 15 lives reported lost.
Trover	Stern-wheel; 160 by 32 feet.	Fort Benton trade	July, 1867	Trover or Franchette Point.	Falling river	Landed for the night in an eddy. The river was falling fast and left her high and dry by the next morning. The boat was abandoned.
Twilight	Side-wheel; 180 by 32 feet.	Mountain trade	Sept., 1865	Opposite mouth Fire Creek, ½ mile above Napoleon.	Snag	The Twilight was sunk on up trip, heavily loaded. For years parties have been working to recover the contents of her hold and have partially succeeded in doing so.
Tyler	Stern-wheel	Missouri River trade. Capt. Al. Dodd, master.	1878–79	Just above St. Charles, Mo.	Unknown	

Undine	Center-wheel	Ferryboat	Apr. 13, 1886	Just above Bismarck Bridge.	Ice	Was built out of the old Denver.
Urilda	Stern-wheel	Missouri River trade	Apr. 24, 1860	Foot of Kate Sweeney Bend.	Snag	
Vienna	Stern-wheel; 73 tons.	do	Dec. 10, 1889	½ mile below New Haven, Mo.	do	Boat and cargo a total loss. No lives lost.
Vint Stillings	Stern-wheel	do		Sioux City, Iowa	Ice	
Viola Belle	Side-wheel	do	Aug. 27, 1871	Smiths Bar, Doniphan Bend.	Snag	Boat and cargo a total loss. Boat valued at $15,000. No lives lost.
Walker, W. W.	Stern-wheel	do	Nov. 14, 1874	Near Plattsmouth, Nebr.	do	
Wakendah	Side-wheel; 160 by 27 feet; 300 tons.	Missouri River trade. Owned by Messrs. Converse, Blain, Tompkins, Kennet and White; Capt. J. M. Converse, master.	Apr. 2, 1846	Mouth of Fishing River.	Rocks	Struck the rocks at Sibley Chain-of-Rocks.
Walk-in-the Water	Side-wheel	Missouri River trade	In the '30's	Thomas or Millers' Bend.	Snag	
Warsaw	Smallest class of boats.	do	Mar., 1846	Bonhomme Island (Lower Island).	do	Had in tow hull of the wrecked steamer Lexington, which was cut loose and saved. The Warsaw had little or no freight on board.
Washington	Center-wheel	Ferryboat	Apr. 10, 1880	Hermann, Mo.	Fire	
Watson	Towboat	Towing; Captain Reneke, master.		Just below Amazonia, Mo.	Unknown	
Watosa	Stern-wheel	St. Joseph and Council Bluffs.	Sept. 26, 1858	12 miles above St. Joseph, Mo.	Snag	Bound from Council Bluffs to St. Joseph. Sank in 15 feet of water. Boat and cargo a total loss. No lives lost.
Waverly	Side-wheel; 200 by 34 feet; 280 tons.	St. Louis and Fort Benton. Captains J. P. Kaiser, Thos. W. Ray and Thos. Raigin, owners; Capt. Thos. Raigin, master.	Nov. 25, 1867	Bowling Green Bend	do	She was brought out new in 1866, making her first trip to Fort Benton. She made $50,000 in one trip.
Wenona	Side-wheel	Missouri river trade	Nov. 10, 1855	Stanleys Island, near Claysville, Mo.	do	Sank in 9 feet of water on down trip from Glasgow, Mo. Boat valued at $12,000.
Western	Stern-wheel; 212 by 34 feet.	Fort Benton trade. Coulson Line, owners.	Mar. 29, 1881	Yankton, S. Dak.	Ice	Was cut down by the ice and crushed against the bank and sunk during the great gorge of ice at Yankton. After the boat sank a large field of ice ran against her with such force as to flatten her port boilers.
Weston	Side-wheel	Missouri River trade. Capt. Wm. Littlejohn, master.	1843	Head of St. Charles Island.	Fire	Fire was discovered in the hold after it had made considerable progress. The hatches were fastened down to confine the fire to the hold, and boat run ashore. The cabin furniture, books of the boat, baggage, and lives of the passengers and crew were saved. An unsuccessful attempt was made to scuttle the boat. The cargo consisted principally of hemp, tobacco, and wheat. The Weston was a fine new boat, and was insured at Pittsburg for $8,000. There were nearly 70 passengers on board, and through the coolness and presence of mind of her officers they all escaped uninjured.

List of steamboat wrecks on the Missouri River, from the beginning of steamboat navigation to the present time—Continued.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
West Wind	Side-wheel; 247 tons.	Government service	Oct. 16, 1864	Glasgow, Mo	Fire	The West Wind had brought troops down the river and landed them at Glasgow a day or two before the town was attacked by Gen. John B. Clarke and Gen. Joe O. Shelby. The town was captured Saturday, October 15, 1864, after a day's fighting. The boat was burnt the following night.
William Baird	Stern-wheel.	Missouri River trade	Apr. 19, 1858	1 mile below and opposite Waverly, Mo.	Snag	Bound from St. Louis to Sioux City with a large and valuable cargo and 150 passengers. Boat and cargo a total loss; no lives lost. Boat valued at $10,000.
Zephyr	do	Irregular trade. Owned by Ben. Johnson.	About 1875	Near Sibley, Mo	Rocks	This boat was built for the Arkansas River trade.

WRECKS ON THE YELLOWSTONE RIVER.

Name of boat.	Description of boat.	Trade engaged in, and owners and officers.	Date of wreck.	Locality of wreck.	Cause of wreck.	Remarks.
James E. Rankin	Stern-wheel	Yellowstone River trade	Oct. 5, 1877		Unknown	The Rankin had been lying on a bar in the Yellowstone for some time. She was pulled off and then sank.
Yellowstone	do	do	1877	Buffalo Rapids, in Yellowstone River.	Rapids	Boat was being pulled over rapids by line when the line parted and boat was carried down on the rocks and sunk.
Osceola	do	Government work	1877	A little above Glendive.	Cyclone	The cylone tore off everything down to the hull. The wreck was was abandoned. Cargo mostly a loss.

APPENDIX E.

REPORT ON BRIDGES OVER MISSOURI RIVER, BY A. H. BLAISDELL, ASSISTANT ENGINEER.

MISSOURI RIVER COMMISSION, OFFICE OF THE SECRETARY,
St. Louis, Mo., June 16, 1897.

CAPTAIN: I have the honor to submit herewith, at your request, a list of bridges over the Missouri River, with some comments upon them as obstructions to navigation.

MISSOURI RIVER BRIDGES.

Any bridge built over a river with its piers in the waterway is to a greater or less degree an obstruction to navigation.

In selecting the site for a bridge crossing, the construction company is guided by consideration of economies in location, approaches, grades, and curvature, but little regard being paid to any other interests than their own, and in consequence many of the Missouri River bridges have been located at points not favorable to the interests of navigation, such, for instance, as the foot of a caving bend, or in a very changeable reach of the river.

Notwithstanding the clause in their charters "that the piers of the bridge shall be built parallel with the current," in an alluvial river like the Missouri, the channel is constantly varying on account of caving banks, and perhaps on no bridge over the Missouri River has the current for any length of time maintained itself in the precise direction it occupied at the time the bridge plans were submitted to the Secretary of War for approval.

There are a number of instances in the localities of Missouri River drawbridges where the steamboat channel has entirely left the drawspans and gone under one of the fixed spans, thus making the bridge, for the time being, the head of navigation of the river.

In the autumn of 1886 for over two months the United States towboat *Wm. Stone* could not pass above the Kansas City Bridge, and in 1888 the Atchison Bridge was impassable from the same cause during a time when the United States were engaged in improving the river at points above; the plant for which had to be passed by hand between towboats on either side of the bridge.

In September, 1888, the Missouri River Commission recommended by resolution "that all bridges over the Missouri River shall be high bridges with continuous and unbroken spans," etc., but since that date four drawbridges have been built across the river under charters granted by Congress, notwithstanding this recommendation.

The piers of bridges, on account of their nonparallelism with the current, give rise to cross currents, and by obstructing the waterway produce increased local velocities, the effects of which on his boat's course the most experienced pilot can not with certainty foretell, and these difficulties are always increased by wind.

The occasion is rare indeed when a long-distance packet has not been subjected to expensive delays near a bridge waiting for a favorable condition of wind and current to make the run through it.

It is thought no Missouri River bridge can make the claim that no accident to water craft has resulted from its construction; the only difference appears to be that the loss on some has exceeded that on others.

The Boonville, Glasgow, and Omaha bridges can each be credited with the total loss of one steamboat by collision with their piers, while the St. Charles Bridge can be credited with two.

Many other accidents involving partial loss of steamers and barges, or total loss of the latter, are on record.

Details of measurements of the bridges across the Missouri River between its mouth and Fort Benton, Mont., as shown in the appended list, are published in the reports of the Missouri River Commission for the years 1893, 1894, and 1896.

Very respectfully, your obedient servant,

A. H. BLAISDELL, *Assistant Engineer.*

Capt. H. M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

Missouri River bridges between the mouth and Fort Benton, Mont.

	Operated by.	Date of completion.	Miles above mouth.	Character of bridge.
Bellefontaine, Mo	St. Louis, Kansas and Northwestern R. R.	December, 1892	8.2	High.
St. Charles, Mo	Wabash R. R	May, 1871; rebuilt 1884.	28	Do.
Jefferson City, Mo	Jefferson City Bridge and Transit Co.	April, 1896	151.2	Draw.
Boonville, Mo	Missouri, Kansas and Texas R. R.	1874; rebuilt 1896	205.8	Do.
Glasgow, Mo	Chicago and Alton R. R	1879	237.5	High.
Sibley, Mo	Atchison, Topeka and Santa Fe R. R.	1888	350	Do.
Randolph Bluffs, Mo	Chicago, Milwaukee and St. Paul R. R.	1887	386.7	Do.
Kansas City, Mo	Kansas City and Atlantic Railroad Co.	Piers only built	390.2	Lift.
Do	Hannibal and St. Joseph R. R. Co.	July, 1869; rebuilt 1891, etc.	390.7	Draw.
Leavenworth, Kans	Leavenworth Terminal Rwy. and Bridge Co.	December, 1893	421.7	Do.
Fort Leavenworth, Kans.	Chicago, Rock Island and Pacific R. R.	1872	424	High.
Atchison, Kans	Atchison Bridge Co	September, 1875	447.8	Draw.
St. Joseph, Mo	St. Joseph Bridge Co	1872–73	479	Do.
Rulo, Nebr	Burlington and Missouri R. R. in Nebraska.	1887	537.5	High.
Nebraska City, Nebr	do	August, 1888	607.7	Do.
Plattsmouth, Nebr	do	August, 1880	633.6	Do.
Omaha, Nebr	Union Pacific R. R	1872; rebuilt 1887	659.1	Do.
Do	Omaha and Council Bluffs R. R. and Bridge Co.	November, 1888	659, 8	Do.
Do	Omaha Bridge and Terminal Rwy. Co.	Partly temporary, about 1893.	662.2	Draw.
Blair, Nebr	Chicago and Northwestern R. R.	November, 1883	694.6	High.
Sioux City, Iowa	Chicago, St. Paul, Minneapolis and Omaha R. R.	November, 1888	805.7	Do.
Do	Combination Bridge Co	January, 1896	807.5	Draw.
Bismarck, N. Dak	Northern Pacific R. R	October, 1882	1,450.1	High.
Fort Benton, Mont	Wagon bridge	1888	2,284.8	Draw.

APPENDIX F.

ANNUAL REPORT OF SAMUEL H. YONGE, DIVISION ENGINEER, OMAHA AND COUNCIL BLUFFS.

MISSOURI RIVER COMMISSION, OFFICE OF DIVISION ENGINEER,
Nebraska City, Nebr., June 10, 1897.

CAPTAIN: I have the honor to submit my report of the operations conducted under my charge on the work of improving the Missouri River in the vicinity of Omaha, Nebr., and Council Bluffs, Iowa, during the fiscal year ending June 30, 1897, as follows:

Shortly after the close of the last fiscal year I was assigned by the president of the Commission to the charge of improvements to be conducted under your direction on Omaha division.

The improvements projected comprised completing the system of dikes begun in the spring of 1895, and making repairs to revetment in the vicinity of Omaha, Nebr., and Council Bluffs, Iowa; also the construction of new works near Nebraska City, Nebr., Atchison, Kans., and Leavenworth, Kans.

In accordance with instructions of the president of the Commission, the necessary plant for carrying on work at the above-named points was transferred from Osage division of first reach. It was forwarded August 22 to Council Bluffs, Iowa, in tow of the United States towboat *Alert*, the United States steam tender *Atalanta*, and the chartered towboat *John R. Hugo*.

It consisted of the *Atalanta*, four 64-foot barges, two 100-foot barges, two small quarter boats, one Vulcan steam hammer driver, one hydraulic pile-sinker pump boat, and one office boat; also a complement of tools and mess utensils for a small working party.

The towboats reached Charleston bar September 4, where, on account of the draft of the *Alert*, 43 inches, being 6 inches greater than the depth of water on the crossing, the boat was recalled. Her tow was subsequently taken as far as Plattsmouth by the other boats, near which point the *Atalanta* was disabled by having her boiler burned. This made it necessary for the *Hugo* to complete the towing of plant to Council Bluffs, which was accomplished September 20.

As soon as the plant reached Council Bluffs a party was organized and sent about 10 miles up the river on the two quarter boats to procure a supply of brush and poles. The party remained in the field until November 14 and procured 2,227 cords. The brush was towed an average distance of 8 miles. Its cost per cord, including all expenses except towing, amounted to $1.77+.

There were also procured, by days' labor, from near the mouth of Boyer Creek, 235 cottonwood piles, the cost of which per linear foot, including all expenses except towing, amounted to $0.117+.

Other materials required for the work were purchased under ten days' advertisement, as follows: 970½ cubic yards of stone, at $1.17 per yard; 65 long leaf yellow-pine piles, at 17$\frac{7}{10}$ cents per linear foot, and 4,160 feet B. M. yellow-pine lumber, at $14 per 1,000 feet B. M., all delivered on the river bank at the boat yard.

The towing of plant and construction material incidental to carrying on work was done by the steamer *John R. Hugo*, which was chartered with a crew, at the rate of $40 per day.

The operations conducted in the vicinity of Omaha and Council Bluffs covered two periods, the fall and early winter of 1896 and the spring of 1897. During the former the training dike, its adjacent cross dikes, Nos. 2, 3, and 4, and the detached dikes, Nos. 5 and 6, were completed, and repairs made to the revetment of 1892.

Incidental to carrying on improvement work during the fall, the old launching ways at the Council Bluffs boat yard were reconstructed for storing plant during the winter, a low-water survey of the reach between the mouth of Pigeon Creek and the Union Pacific Railway Bridge made, and, on the suspension of field work for the winter, the fleet of 12 boats taken out of the river and stored on the ways.

Spring operations comprised the launching of the fleet, the construction of Dike No. 7, the dismantling of the boat yard, and the loading on barges of material and property for shipment down the river to other points where work was projected.

DIKE CONSTRUCTION.

Pile driving was begun September 24 on the training dike at the stream end of Cross Dike No. 2, with the Vulcan steam hammer. This machine was used on dike work until October 8, when the pile driving for the training dike, with the exception of about 150 feet at its lower end, was completed.

On October 6 arrangements were made for hiring a pile driver with water-jet attachments, which had been used on the work in 1895. The apparatus, being dismantled, had to be assembled and installed on a barge. It was not ready for service until October 21.

The machine proved to be inefficient, and as the other branches of dike work could not be proceeded with in advance of the pile driving the progress of work was delayed and its cost increased.

Pile driving on the training dike was completed October 27; that for Dikes Nos. 5 and 6 was then taken up and was completed November 20.

The total number of dike piles placed during the fall and early winter amounted to 382, with an average penetration of 25.82 feet.

The design of the training dike included a woven mattress apron 120 feet wide in front of the stream line of piling. About 1,100 feet of the apron had been placed when work was suspended in 1895. This left still to be constructed about 1,600 feet, in two sections—one about 300 feet long opposite Dike No. 2, the other about 1,300 feet long, extending from about 250 feet above Dike No. 3 to the lower end of the training dike. The weaving of the upper section was begun September 28 and completed October 2. The weaving of the lower section was begun October 12 and completed October 28. The new sections of mattress overlap the adjacent old ones.

The weaving of foot mat for Dike No. 5 was begun November 2 and completed November 9. That for Dike No. 6 was begun November 10 and completed November 22. The river being frozen at Dike No. 6 during the last few days of mat weaving, the mat was woven on top of the ice without a mattress boat.

When work on the training dike was suspended in 1895, 94 of the piles were left standing unbraced. During the ensuing high water these piles were bent over by the current to a greater or less extent. As the bracing could not be properly applied to the piles without straightening them, they were drawn back to their original position as nearly as possible. This was accomplished by using the capstan of the hydraulic pile-sinker pump boat, a water jet supplied from the same boat being used simultaneously for loosening and washing away the sand from around the pile.

The training dike and Dikes Nos. 5 and 6 were completed November 6, 13, and 30, respectively.

It was not considered advisable to construct Dike No. 7 in the fall and early winter of 1896, as it would thereby have been exposed to the full force of moving ice the following spring, before any backing of accretions could have been formed by it.

The necessary piling was procured during the winter and it was expected to construct the dike during the low-water period, which generally follows the breaking up of the ice in the early spring.

A late opening of the river and stormy weather delayed launching the plant, so that preparations for beginning work were not completed until April 6.

Although the river was then at a flood stage and above the proposed grade of the dike, considerable expense having been incurred in making preparations and organizing the working crews, the work was proceeded with.

On April 12, a general overflow of the river banks being imminent, work was suspended and was not resumed until April 21. The construction of the outer half of the dike was attended with unusual difficulties, on account of the prevailing flood stage and floating driftwood; also on account of being situated directly in the channel, 30 to 40 feet deep, and receiving the full impact of the current, sometimes having velocities as high as 8 to 10 feet per second.

The pile structure is 150 feet long with a 60-foot "L." It consists of three lines of piling, 17 feet between centers, braced in the manner shown on Plate II. The upper line of piling is reenforced at the outer bent with two piles, forming a cluster, and at each of the next nine bents with one pile, the contiguous piles being bolted together. With the exception of ten piles near the shore end of the dike, these members are long-leaf pine.

The piles are braced by the usual top system of bracing, consisting of transverse direct braces, top diagonals, and wales. They are also braced by vertical diagonal braces between the top of the front and middle, and the bottom of the middle and back rows, respectively. The lower end of each brace is hinged to its pile by a 1¼-inch eyebolt (fig. 2, Pl. II), the body of the bolt passing through the pile with its eye in the brace, the end of the brace being gained out to receive it. A 1¼-inch bolt through the brace and the eye of the eyebolt completes the hinge. The lower end of the brace is shaped so as to allow it to revolve between a vertical and its final inclined position against the top of the pile ahead, into which it is gained 3 inches, and fastened with ½ by 10 inch spikes. A wooden angle block is gained into the pile below the heel of each brace to receive the thrust, if from any cause the brace should settle. Each brace was attached to its pile before the latter was placed in the leads, and was held erect during the driving of the pile by being fastened to it.

Each pile bent is also braced by a double ⅜-inch wire cable stay extending from the front pile at the ground to the back pile at its head. The cable is made of 49 No. 15 galvanized Bessemer steel wires, in seven strands, one of which serves as a core. The attaching of the stays to the front piles was done by giving each stay a complete turn around its pile and spiking it with four ⅜ by 8 inch spikes. The tightening of the stays in their final positions on the back piles was accomplished by means of a jackscrew supported by an angle block suspended from the head of the back pile (fig. 3, Pl. II), the ends of the stay being passed through an iron plate attached to the head of the jackscrew and clamped to prevent slipping.

After giving the stay the necessary tension with the jack, it was stapled against each side of the pile or direct brace by two ½ by 10 inch spikes, and the free ends turned twice around the pile and fastened with ⅜ by 8 inch spikes.

The dike foot mat extends 12 feet beyond the stream bent, and was successfully ballasted and sunk. An apron was subsequently woven outside the stream end of the dike and, to insure its successful sinking to the bottom, every possible precaution taken. The attempt, however, failed, the mat being rolled up and torn by the current before reaching the bottom, breaking down a cluster of three piles to which it was moored by ⅜-inch wire strand.

After frequent interruptions from stormy weather the dike was completed May 5.

In accordance with the instructions of the president of the Commission, no screen was placed on the dike.

The dike piles have an average penetration of 26.44 feet; those in the "L" of 16.1 feet.

The details of extent and net cost of dike work are given in Exhibit A.

The positions of the dikes are indicated on the accompanying map of survey of the fall of 1896.

Through the agency of the training and cross dikes, an almost unbroken batture, having about their same general elevation, has been formed between the training dike and the old river bank, thus making a new shore line on the line of the training dike. These works make the revetment above the Interstate Bridge reasonably safe against flanking.

The effect of extending Dikes Nos. 5 and 6 to the line of the training dike prolonged, and constructing Dike No. 7, has not been accurately determined. The center of gravity of section of the reach between Dike No. 7 and a point 1,600 feet below, however, is now apparently farther away from the bank than prior to constructing the above works. This makes the revetment of that part of the bank less liable to being undermined.

There has been no material change in position of the channel at the Interstate Bridge. It is still under the middle fixed span at low stages, and under the north arm of the drawspan at high stages.

REVETMENT CONSTRUCTION AND REPAIR.

During the interval between the suspension of work in the fall of 1895 and its resumption in 1896 the revetment of 1892, between Dike No. 7 and a point about 1,450 feet below, was damaged at four different places, aggregating about 790 linear feet, by being undermined. This was caused by the flow, after following the training dike, concentrating and forming a gorge section in front of the bank referred to, the subaqueous mattress settling and the bank behind it caving as the section in front of the mattress deepened by scour.

With the exception of 360 feet immediately above the old launching ways, the mattress was held by its anchor cables and appeared to be intact. For the above distance and the adjacent 160 feet below it, occupied by the launching ways, where no subaqueous mattress had been placed, a mattress 520 feet long by 66 feet wide from low water was woven. The slope of the upper bank was also restored by filling voids, formed by caving, with layers of fascines and stone.

The last-described class of repairs was also made to the other parts of the upper bank, which had caved.

The above revetment repairs were made during the fall and early winter of 1896.

The details of extent and net cost of revetment work are given in Exhibit B.

As there is no safe ice harbor in the vicinity of Council Bluffs, the old launching ways were reconstructed and a set of tracks, with sufficient capacity to store the plant, erected, in as inexpensive a manner as possible. The old ways' incline was found to be occupied by a number of unserviceable flatboats belonging to private individuals, and several weeks elapsed before the owners of the boats could be gotten to remove them. As soon as this was done work on the ways was begun. They were completed October 31.

The laying up of plant on the storage tracks was begun November 1, and was practically completed November 7.

The ring in the *Atalanta's* boiler, which was burned while towing plant up the river, was replaced, and slight repairs made to the hulls of the boats.

The river was closed by ice November 28 at a stage of 2 feet below standard low water.

Operations were suspended December 19 and all employees discharged except an overseer and two watchmen to take care of property.

A movement of the ice occurred January 19, by which the top diagonal bracing at the stream end of Dike No. 5 was lifted and the piles canted. This damage was repaired in February and the ice cut away along the lower hundred feet of the training dike to relieve it from stress of moving ice. The river opened at the boatyard March 16, at a stage of about 4¼ feet above standard low water, without doing any damage to the dikes.

The ice from gorges below Sioux City, Iowa, passed the boatyard between March 20 and 23.

Very inclement weather delayed completing necessary repairs to the calking of the plant until March 28, when the launching of plant was begun.

Launching was completed April 3, after which the part of the ways above water and the storage tracks were dismantled and, with the other property pertaining to the work, loaded on barges for shipping down the river.

The operations were concluded May 10, on which date the towing of plant to Nebraska City was completed.

Very respectfully, your obedient servant,

SAML. H. YONGE, *Division Engineer.*

Capt. HIRAM M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

EXHIBIT A.

Statement of extent and net cost of dike work.

TRAINING DIKE.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Placing 100 piles with steam hammer:			
4,752 linear feet oak piling	$0.176+	$838.92	
200 bushels coal	.106+	21.21	
Labor and subsistence		202.70	$1,062.83
Placing 51 piles with jet driver:			
837 linear feet oak piling	.176+	147.76	
1,642 linear feet cottonwood piling	.117+	193.71	
183½ bushels coal	.106+	19.46	
Hire of driver		124.38	
Labor and subsistence		131.06	616.37
Straightening 94 piles:			
62 bushels coal	.106+	6.57	
Labor and subsistence		72.13	78.70
Weaving 1,311 linear feet (157,359 square feet) willow mattress:			
1,275½ cords brush	1.771+	2,258.95	
44,467 feet ⅜-inch wire strand	.007+	312.60	
2,480 feet 1¼-inch wire cable	.015	37.20	
104½ pounds No. 12 wire	.022	2.30	
17 clevises	.057+	.98	
Labor and subsistence		1,852.37	3,964.40
Ballasting 1,311 linear feet (157,359 square feet) willow mattress:			
1,777 cubic yards stone	1.349+	2,398.20	
Labor and subsistence		501.22	2,899.42
Attaching top braces to 1,300 linear feet 3-row dike:			
81,339 feet B. M. yellow-pine lumber	17.508	1,424.08	
1,851 screw bolts	.113+	210.55	
860 drift bolts	.11	94.60	
3,448 wrought washers	.003+	10.79	
181 O. G. washers	.03	5.43	
385 pounds spikes	.025	9.63	
435 pounds nails	.033+	14.57	
Labor and subsistence		721.75	2,491.40
Screening 1,300 linear feet of dike:			
71½ cords screening poles	1.771+	126.63	
483 pounds nails	.033+	16.18	
Labor and subsistence		161.25	304.06
Filling in hole: Labor and subsistence		14.58	14.58
Towing material and moving plant:			
Hire of towboat		981.45	
1,790 bushels coal	.106+	189.78	1,121.23
Total			12,552.99

DIKE NO. 2.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Placing five piles with steam hammer:			
200 linear feet oak piling	$0.176+	$35.31	
10 bushels coal	.106+	1.06	
Labor and subsistence		13.04	$49.41
Attaching top braces to 80 linear feet 2-row dike:			
955 feet B. M. yellow-pine lumber	17.508	16.72	
15 screw bolts	.113	1.71	
61 drift bolts	.11	6.71	
152 wrought washers	.003+	.48	
Labor and subsistence		19.70	45.32
Screening 50 linear feet of dike:			
2 cords screening poles	1.771+	3.54	
33 pounds nails	.033+	1.11	
Labor and subsistence		14.30	18.95
Towing material and moving plant:			
Hire of towboat		9.25	
17½ bushels coal	.106+	1.86	11.11
Total			124.79

Statement of extent and net cost of dike work—Continued.

DIKE NO. 3.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Attaching top braces to 20 linear feet 2-row dike:			
496 feet B. M. yellow-pine lumber	$17.508	$8.68	
15 screw bolts	.113+	1.71	
Labor and subsistence		3.00	
			$13.39
Screening 50 linear feet of dike:			
12 pounds nails	.033+	.40	
2 cords screening poles	1.771+	3.54	
Labor and subsistence		6.20	
			10.14
Towing material and moving plant:			
Hire of towboat		1.90	
4 bushels coal	.106+	.42	
			2.32
Total			25.85

DIKE NO. 4.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Attaching top braces to 270 linear feet 2-row dike:			
9,576 feet B. M. yellow-pine lumber	$17.508	$167.66	
336 screw bolts	.113+	38.22	
108 drift bolts	.11	11.88	
582 wrought washers	.003+	1.82	
23 pounds spikes	.025	.58	
35 pounds nails	.033+	1.17	
Labor and subsistence		89.74	
			$311.07
Towing material and moving plant:			
Hire of towboat		25.35	
49 bushels coal	.106+	5.20	
			30.55
Total			341.62

DIKE NO. 5.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Placing 7 mooring piles with jet driver:			
296 linear feet cottonwood piling	$0.117+	$34.92	
40 clevises	.057+	2.30	
20 bushels coal	.106+	2.12	
Hire of driver		17.07	
Labor and subsistence		24.42	
			$80.83
Placing 90 dike piles with jet driver:			
2,365 linear feet oak piling	.176+	417.52	
1,528 linear feet cottonwood piling	.117+	180.26	
223 bushels coal	.106+	23.64	
111 clevises	.057+	6.38	
Hire of driver		219.50	
Labor and subsistence		210.15	
			1,057.45
Weaving 378 linear feet (29,580 square feet) willow mattress:			
194 cords brush	1.771+	343.58	
2,746 feet ¼-inch wire strand	.007+	19.30	
Labor and subsistence		276.23	
			639.11
Ballasting 378 linear feet (29,580 square feet) willow mattress:			
247 cubic yards stone	1.349+	333.35	
Labor and subsistence		71.46	
			404.81
Attaching top braces to 342 linear feet 3-row dike:			
13,688 feet B. M. yellow-pine lumber	17.508	239.65	
302 screw bolts	.113+	34.35	
175 driftbolts	.11	19.25	
564 wrought washers	.003+	1.77	
39 O. G. washers	.03	1.17	
85 pounds spikes	.025	2.13	
85 pounds nails	.033+	2.85	
1,470 feet 1½-inch cable	.015	22.05	
Labor and subsistence		168.74	
			491.96
Repairing bracing damaged by ice:			
851 feet B. M. yellow-pine lumber	17.508	14.90	
30 driftbolts	.11	3.30	
6 screw bolts	.113+	.68	

Statement of extent and net cost of dike work—Continued.

DIKE NO. 5—Continued.

Class and extent of work and quantities of material, etc	Cost per unit.	Cost of each item.	Total.
Repairing bracing damaged by ice—Continued.			
28 pounds spikes	$0.025	$0.70	
Labor		55.00	$74.58
Screening 140 linear feet of dike:			
9 cords screening poles	1.771+	15.94	
85 pounds nails	.033+	2.85	
Labor and subsistence		21.05	39.84
Miscellaneous expenses:			
Labor and subsistence		63.25	63.25
Towing material and moving plant:			
Hire of towboat		232.35	
447 bushels coal	.106+	47.39	279.74
Total			3,181.57

DIKE NO. 6.

Class and extent of work and quantities of material, etc	Cost per unit.	Cost of each item.	Total.
Placing 3 mooring piles with jet driver:			
134 linear feet cottonwood piling	$0.117+	$15.81	
10 bushels coal	.106+	1.06	
Hire of driver		7.31	
Labor and subsistence		6.00	$30.18
Placing 130 dike piles with jet driver:			
2,695 linear feet oak piling	0.176+	475.78	
3,588 linear feet cottonwood piling	.117+	423.28	
20 clevises	.057+	1.15	
307½ bushels coal	.106+	32.60	
Hire of driver		317.06	
Labor and subsistence		291.94	1,541.81
Weaving 453 linear feet (34,785 square feet) willow mattress:			
247 cords brush	1.771+	437.44	
3,659 feet ⅜-inch wire strand	.007+	25.72	
20 clevises	.057+	1.15	
Labor and subsistence		352.36	816.67
Ballasting 453 linear feet (34,785 square feet) willow mattress:			
333½ cubic yards stone	1.349+	449.75	
9 pounds No. 12 wire	.022	.20	
Labor and subsistence		306.49	756.44
Attaching top braces to 407 linear feet 3-row dike:			
17,211 feet B. M. yellow-pine lumber	17.508	301.33	
332 screw bolts	.113+	37.76	
188 driftbolts	.11	20.68	
611 wrought washers	.003+	1.91	
10 O. G. washers	.03	.30	
48 pounds spikes	.025	1.20	
100 pounds nails	.033+	3.35	
Labor and subsistence		179.42	545.95
Attaching 11 pairs stay cables:			
47 pounds spikes	.025	1.18	
5 pounds nails	.033+	.17	
1,350 feet 1¼-inch cable	.015	20.25	
Labor		45.60	67.20
Breaking up and clearing ice from around mattress boat:			
Labor and subsistence		42.45	42.45
Carrying material by hand across the ice from the shore to the dike:			
Labor and subsistence		113.15	113.15
Towing material and moving plant:			
Hire of towboat			
612 bushels coal		318.90	
	.106+	64.89	383.79
Total			4,297.64

Statement of extent and net cost of dike work—Continued.

DIKE NO. 7.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Placing 16 mooring piles with steam hammer:			
45 linear feet oak piling	$0.176+	$7.94	
840 linear feet cottonwood piling	.117+	99.09	
5 pounds nails	.033+	.17	
40 bushels coal	.104+	4.18	
Labor	....	59.84	
			$171.22
Placing 74 dike piles with steam hammer:			
3,582 linear feet pine piling	.187+	671.95	
428 linear feet oak piling	.176+	75.56	
180 bushels coal	.104+	18.80	
60 feet ⅜-inch wire strand	.007+	.42	
Labor	....	208.08	
			974.81
Weaving 301 linear feet (21,047 square feet) willow mattress:			
149½ cords brush	1.771+	264.77	
8,800 feet ⅜-inch wire strand	.007+	61.86	
4 clevises	.057+	.23	
Labor	....	253.13	
			579.99
Ballasting 174 linear feet (14,042 square feet) willow mattress:			
391¾ cubic yards stone	1.349+	528.59	
99 pounds No. 16 wire	.024	2.38	
Labor	....	171.73	
			702.70
Attaching top braces to 210 linear feet 3-row dike:			
13,789 feet B. M. yellow-pine lumber	17.508	241.42	
85 driftbolts	.11	9.35	
192 screw bolts	.113+	21.84	
50 pounds nails	.033+	1.68	
410 wrought washers	.003+	1.28	
480 feet ⅜-inch wire strand	.007+	3.37	
Labor	....	105.47	
			384.41
Framing and attaching 22 drop braces:			
4,586 feet B. M. yellow-pine lumber	17.508	80.29	
22 1½-inch eyebolts	.58	12.76	
20 pounds nails	.033+	.67	
345 pounds spikes	.025	8.63	
320 feet ⅜-inch wire strand	.007+	2.25	
Labor	....	123.83	
			228.43
Attaching 17 pairs stay cables:			
97 pounds spikes	.025	2.43	
1,900 feet ⅝-inch steel cable	.037	71.06	
Labor	....	30.89	
			104.38
Clearing dike of driftwood:			
Labor	....	24.49	
			24.49
Towing material and moving plant:			
Hire of towboat	....	80.00	
407 bushels coal	.104	42.50	
			122.50
Total	....	....	3,292.93

EXHIBIT B.

Statement of extent and net cost of revetment work.

CONSTRUCTING 520 LINEAR FEET OF SUB-BANK PROTECTION.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Placing 16 anchor piles with steam hammer:			
608 linear feet cottonwood piling	$0.117+	$71.25	
20 bushels coal	.106+	2.12	
Labor and subsistence	....	31.80	
			$105.17
Drawing old submerged way piles:			
40 bushels coal	.106+	4.24	
Labor and subsistence	....	140.82	
			145.06

Statement of extent and net cost of revetment work—Continued.

CONSTRUCTING 520 LINEAR FEET OF SUB-BANK PROTECTION—Continued.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Weaving 520 linear feet (34,460 square feet) willow mattress:			
221 cords brush	$1.771+	$391.40	
840 feet 1¼-inch wire cable	.015+	12.60	
6,705 feet ⅜-inch wire strand	.007+	47.14	
13 pounds No. 12 wire	.022	.29	
Labor and subsistence	....	250.26	$701.69
Ballasting 520 linear feet (34,460 square feet) willow mattress:			
242½ cubic yards stone	1.349+	327.27	
Labor and subsistence	....	66.60	393.87
Towing material and moving plant:			
Hire of towboat	....	109.65	
211 bushels coal	.106+	22.37	132.02
Total	....	....	1,477.81

REPAIRING 790 LINEAR FEET OF UPPER-BANK PROTECTION.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Restoring bank grade by filling voids with fascines and stone:			
144 cubic yards stone	$1.349+	$194.34	
Labor and subsistence	....	309.13	$503.47
Regrading bank:			
Labor and subsistence	....	48.67	48.67
Ballasting 900 square feet upper bank with stone:			
29 cubic yards stone	1.349+	39.14	
Labor	....	36.31	75.45
Towing material and moving plant:			
Hire of towboat	....	51.15	
98 bushels coal	.106+	10.39	61.54
Total	....	....	689.13

APPENDIX G.

ANNUAL REPORT OF SAMUEL H. YONGE, DIVISION ENGINEER, NEBRASKA CITY, NEBR.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Nebraska City, Nebr., June 30, 1897.

COLONEL: I have the honor to submit my report of operations conducted in improving the Missouri River in the vicinity of Nebraska City, Nebr., for the fiscal year ending June 30, 1897.

NOTES ON THE REGIMEN OF THE RIVER.

According to the map accompanying the annual report for 1891, the head of the Nebraska City Island revetment was situated where Dike No. 2 is shown on the map herewith submitted. The present head of the revetment is at "A" (Plate I), about 400 feet below Dike No. 2, that extent of work having been flanked or undermined.

This damage, which has occurred since last fall, was brought about through the agency of an extensive reef reaching from the bluffs about a mile below the mouth of Walnut Creek to within a quarter of a mile of the Burlington and Missouri Railroad bridge at Nebraska City.

The main channel in this vicinity is usually between the reef, for almost its entire length, and the left bank; secondary channels through different parts of the reef, alternately forming and filling back for every slight change of stage.

In the fall of 1896 a pocket was formed by the reef's action, adjacent to and immediately above the head of the revetment, and about 100 feet of the work flanked.

Between May 12 and 15, 1897, the 200 feet adjacent to and below the pocket were undermined by the part of the reef opposite, building up and extending about 100 feet toward the shore.

About May 19, a channel formed through the reef opposite the head of the pocket. The opening gradually enlarged until it attained a width of about 900 feet on May 26 (Plate I). This flow impinged against the city water front, causing a slight bank caving for about 2,000 feet above the waterworks pumping station.

In the early part of June, other channels were formed through the reef some distance farther upstream, while the one just described silted up considerably, the bank-caving along the water front coincidently ceasing.

From June 12 to 15, slight bank-caving just above the city waterworks pumping station resulted from a recurrence of somewhat similar conditions to those prevailing in the latter part of May.

A comparison of the maps of 1891 and 1897 shows that there has been some bank erosion during that period along the city front—probably the result of intermittent reef action as briefly outlined above.

DIKE CONSTRUCTION.

It was proposed to check the enlarging of the pocket above referred to, and the consequent flanking of the revetment below it, by three short dikes placed across it, approximately normal to the general direction of flow.

Soundings were made in March, 1897, on which the bills of piling and other material required for the dikes were based.

An examination made May 11, immediately after the arrival of the plant at Nebraska City, showed that since March the depth of water in the pocket had greatly increased by scour. In consequence, most of the piles that had been procured for the dikes were too short. As it was not practicable to get sufficient long piling in time to construct the dikes as originally designed before the June rise, the project was modified by your direction, by substituting two 3-row dikes for the three 2-row dikes. A short 2-row dike, across an eddy situated a short distance below the pocket, was added to the project.

The requirements for long piling were partly filled by procuring such cottonwood piles as were available within an economical hauling distance, and by splicing short pine piles.

Preparations for dike work were completed and pile driving at Dike No. 1 was begun May 19. The dike is 131 feet long, having the outer ten bents 3-row and the inner four 2-row. The pile penetrations vary from 15 to 28 feet, the lesser resulting from a scarcity of long piles.

Mat weaving was begun May 21, and, with the ballasting, completed May 23.

Dike No. 2 is 130 feet long. Its outer eight bents are 3-row, its inner six 2-row work. The piles have an average penetration of 29.8 feet, the minimum being 23¼ feet. After the first six bents of piles were placed, the driving became excessively hard, and a water jet supplied by a steam pump was used in connection with the Vulcan Nasymth hammer to increase the speed.

The bracing of the Nebraska City dikes consists of top direct braces and wales, diagonal cable stays, and direct ground braces, the latter detail being used for the first time. They are designed to diminish distortion of the pile bents frames that would result from the ground behind the piles of the front row yielding when the dike is subjected to stress tending to overturn it. Each ground brace consists of two 4 by 8-inch scantlings bolted and spiked to blocks near their ends, which separate them slightly more than the diameters of the piles which they are to brace. Short plank spiked at intervals to the under edges of the scantlings form a crate between the blocks to hold stone ballast for sinking the brace to place. (Fig. 3, Plate II.)

Preliminary to framing a ground brace, the space which it was to occupy on the ground between the two piles was measured. Several apparatus were made for this purpose, but none were entirely satisfactory, as they frequently failed in swift, deep water to furnish a close enough measurement to insure the requisite snug fit between brace and piles to make the former fully effective. That finally adopted is illustrated in figs. 5 and 6, Plate II. It consists of an iron ring 2 feet in diameter, made of ¾-inch iron, bolted to a long straightedge. The ring being slipped over the pile and the straightedge plumbed with a spirit level, the measurement *a* is made, the constants b and b^1 being added to it to give the total length of brace outside the separating blocks. To place the brace, it was first swung by ⅜-inch wire strands passing over two rollers, one near each end of the brace, supported by two punts. (Fig. 4, Plate II.) It was then loaded with enough stone to give a sinking weight of 300 or 400 pounds in excess of its buoyancy and lowered, being kept approximately level to prevent upsetting by the current and dumping the ballast. This happened whenever the downstream end of a brace was allowed to get much below its upstream end.

As the river was near a flood stage during the construction of the dikes, the conditions for placing the ground braces were unfavorable. They were not infrequently, while being lowered, prevented from reaching the bottom by being bound against the piles by the current, or jammed between the piles either on account of their being crooked or having been driven out of plumb. Whenever this occurred, the appliance shown in figs. 10, 11, and 12, Plate II, was used with more or less advantage to clear the brace by springing the piles apart. It consists of two arms made of 4 by 4-inch pine, each arm having an iron sleeve attached at one end, and a screw working through a nut at the other.

The spreader is adjusted to fit approximately different widths of bent by sliding each arm through the sleeve of the other. The piles are forced apart by turning the screws, the arms being prevented from slipping by an iron link lying diagonally across them, fitting into notches on their outside faces.

After getting the ground braces to the mat, or as near it as possible, the strands used for lowering were spiked to the heads of the adjacent piles.

By your direction the screen was omitted from the outer fifty feet of Dike No. 1 and the outer 30 feet of Dike No. 2. Dike No. 1 was completed May 29.

Work on Dike No. 2 had to be several times suspended on account of high water, and was not completed until June 21.

An improved form of clamp, consisting of a pair of cams with serrated faces, for attaching to the head of the jackscrew used in tightening the stay cables, to prevent them from slipping while being tightened and fastened to the back piles, was used with satisfactory results. Its details are shown in figs. 7, 8, and 9, Pl. II.

To meet the emergency caused by bank-caving along the city water front, previously referred to, by which the pumping station supplying the city's water and the plant furnishing electric light were threatened, I was directed by you to construct three short dikes immediately above the pumping station.

Subsequently, bed rock being found at the sites of the dikes so close to the surface as to make it impossible to give the dike piles proper penetrations, the construction of the dikes was, by your direction, abandoned, and instead a section of bank at the site of each dike, 50 feet long, was ordered protected with 2 cubic yards of stone riprap per linear foot.

This work was begun June 24, and about one-third completed at the close of the fiscal year.

The moving of plant to Leavenworth, Kans., by the steamer *Hugo* began June 24.

The following statement shows the extent and net cost of the improvements:

Statement of extent and net cost of dike work.

DIKE NO. 1.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Placing 5 mooring piles[a] with steam hammer:			
40 linear feet pine piling	$0.230+	$9.22	
10 bushels coal	.10	1.00	
30 feet ⅜-inch wire strand	.007+	.23	
1 pound spikes	.022	.02	
Labor		9.67	
			$20.14
Placing 48 dike piles with steam hammer:			
1,650 linear feet pine piling	.230+	380.49	
420 linear feet oak piling	.176+	73.92	
50 linear feet cottonwood piling	.099+	4.96	
70 bushels coal	.10	7.00	
88 feet ⅜-inch wire strand	.007+	.69	
4 pounds spikes	.022	.09	
Labor		70.58	
			537.73
Weaving 181 linear feet (11,801 square feet) willow mattress:			
90 cords brush	2.279+	205.18	
3,375 feet ⅜-inch wire strand	.007+	26.33	
Labor		135.74	
			367.25
Ballasting 181 linear feet (11,801 square feet) willow mattress:			
139 cubic yards stone	1.545+	214.89	
Labor		64.11	
			279.00
Placing 21 ground braces:			
2,435 feet B. M. yellow pine lumber	19.121+	46.56	
34 pounds nails	.020+	.70	
76 wrought washers	.002+	.19	
454 feet ⅜-inch wire strand	.007+	3.54	
34 screw bolts	.187+	6.38	
158 pounds spikes	.022+	3.48	
12 cubic yards stone	1.545+	18.55	
Labor		66.31	
			145.71

[a] Four of these mooring piles were afterwards drawn.

Statement of extent and net cost of dike work—Continued.

DIKE NO. 1—Continued.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Attaching top braces to 40 linear feet 2-row and 91 linear feet 3-row dike:			
3,822 feet B. M. yellow-pine lumber	$19.121+	$73.08	
102 pounds spikes	.022+	2.26	
120 screw bolts	.187+	22.50	
244 wrought washers	.002+	.61	
50 pounds nails	.020+	1.03	
17 driftbolts	.14	2.38	
140 feet ⅜-inch wire strand	.007+	1.09	
Labor		50.25	
			$153.20
Attaching 13 pairs stay cables:			
156 feet ⅜-inch wire strand	.007+	1.22	
906 feet ¾-inch steel cable	.037+	33.88	
85 pounds spikes	.022	1.87	
10 pounds nails	.020+	.21	
Labor		23.25	
			60.43
Screening 81 linear feet of dike:			
8 cords screening poles	1.771+	14.17	
512 feet B. M. yellow-pine lumber	19.121+	9.79	
10 pounds nails	.020+	.21	
Labor		12.00	
			36.17
Towing material and moving plant:			
Hire of towboat		110.53	
276 bushels coal		27.60	
			138.13
Total			1,737.76

DIKE NO. 2.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Splicing 10 pine piles:			
114 linear feet pine piling *	$0.230+	$26.29	
37 screw bolts	.187+	6.94	
890 feet ⅜-inch wire strand	.007+	6.24	
35 pounds spikes	.022	.77	
25 pounds nails	.020+	.51	
Labor		68.10	
			$108.85
Placing 2 mooring piles with steam hammer:			
100 linear feet cottonwood piling	.099+	9.91	
8 bushels coal	.10	.80	
4 pounds spikes	.022	.09	
Labor		17.52	
			28.32
Placing 46 dike piles with steam hammer:			
983 linear feet pine piling	.230+	226.68	
1,248 linear feet cottonwood piling	.099+	123.68	
122 bushels coal	.10	12.20	
30 pounds spikes	.022	.66	
8 pounds nails	.020+	.16	
Labor		117.28	
			480.66
Weaving 189 linear feet (14,061 square feet) willow mattress:			
96 cords brush	2.279+	218.86	
3,525 feet ⅜-inch wire strand	.007+	27.50	
Labor		131.56	
			377.92
Ballasting 189 linear feet (14,061 square feet) willow mattress:			
145 cubic yards stone	1.545+	224.16	
Labor		26.05	
			250.21
Placing 19 ground braces:			
4,623 feet B. M. yellow-pine lumber	19.121+	88.40	
15 cubic yards stone	1.545+	23.19	
466 feet ⅜-inch wire strand	.007+	2.63	
68 wrought washers	.002+	.17	
7 pounds spikes	.022	.15	
111 pounds nails	.020+	2.28	
1 driftbolt	.14	.14	
36 screw bolts	.187+	6.75	
Labor		63.22	
			187.98

* Lost in cutting splices.

Statement of extent and net cost of dike work—Continued.

DIKE NO. 2—Continued.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Attaching top braces to 24 linear feet 1-row, 58½ feet 2-row, and 71½ feet 3-row dike:			
4,975 feet B. M. yellow-pine lumber	$19.121+	$95.13	
106 screw bolts	.187+	19.88	
12 driftbolts	.14	1.68	
41 pounds spikes	.022	.90	
53½ pounds nails	.020+	1.10	
146 wrought washers	.002+	.37	
134 feet ⅜-inch wire strand	.007+	1.05	
Labor	....	47.87	
			$167.98
Attaching 11 pairs stay cables:			
794 feet ⅜-inch steel cable	.037+	29.70	
271 feet ⅜-inch wire strand	.007+	2.11	
89 pounds spikes	.022	1.96	
10 pounds nails	.020+	.21	
Labor	....	23.35	
			57.33
Screening 119 linear feet of dike:			
6¾ cords screening poles	1.771+	12.04	
12 pounds nails	.020+	.25	
Labor	....	10.50	
			22.79
Towing material and moving plant:			
Hire of towboat	....	112.74	
282 bushels coal	.10	28.20	
			140.94
Total	....	....	1,772.93

DIKE NO. 3.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Placing 8 dike piles with steam hammer:			
290 linear feet pine piling	$0.230+	$66.87	
56 linear feet cottonwood piling	.099+	5.55	
65 bushels coal	.10	6.50	
Labor	....	17.18	
			$96.10
Weaving 39 linear feet (1,443 square feet) willow mattress:			
8 cords brush	2.279+	18.24	
Labor	....	12.16	
			30.40
Ballasting 39 linear feet (1,443 square feet) willow mattress:			
30 cubic yards stone	1.545+	46.38	
Labor	....	18.06	
			64.44
Attaching top braces to 32 linear feet 2-row and 20 linear feet 1-row dike:			
840 feet B. M. yellow-pine lumber	19.121+	16.06	
19 screw bolts	.187+	3.56	
3 pounds nails	.020+	.06	
15 pounds spikes	.022	.33	
40 wrought washers	.002+	.10	
Labor	....	20.79	
			40.90
Screening 38½ linear feet of dike:			
3½ cords screening poles	1.771+	6.20	
8 pounds nails	.020+	.16	
Labor	....	4.60	
			10.96
Towing material and moving plant:			
Hire of towboat	....	16.73	
42 bushels coal	.10	4.20	
			20.93
Total	....	....	263.73

Statement of extent and net cost of dike work—Continued.

STATEMENT OF EXTENT AND NET COST OF STONE REVETMENT.

Class and extent of work and quantities of material, etc.	Cost per unit.	Cost of each item.	Total.
Covering 50 linear feet (1,500 square feet) with stone riprap:			
100 cubic yards stone	$1.18	$118.00	
Labor trimming bank		6.13	
Labor loading and placing stone		70.72	
			$194.85

Very respectfully, your obedient servant,

SAML. H. YONGE, *Division Engineer.*

Lieut. Col. AMOS STICKNEY,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

APPENDIX H.

ANNUAL REPORT OF MR. S. H. YONGE, DIVISION ENGINEER.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Nebraska City, Nebr., June 30, 1897.

COLONEL: I have the honor to submit my report of operations on improving the Missouri River on Osage division of first reach, for the part of current fiscal year terminating August 31, 1896, as follows:

DIKE REPAIRS.

On July 5, 97 feet of Dike 19 B, about 140 feet from its root, was breached. This was followed on July 7, by a breach about 90 feet long, through Dike 19 A, and 50 feet inside the dike head.

The breaches gradually widened till July 31, when that at 19 B attained a width of 110 feet, and that at 19 A of 185 feet.

During the latter part of the June rise, and almost the entire month of July, the Missouri was at a higher stage than the Osage, and there was, in consequence, a strong flow from the latter into the former over Osage Chute Dam. On account also of depressions in the accretions between Dikes 19 A and 19 B, referred to in the last annual report, the current through the outer part of the former and inner part of the latter was very swift. The apparent cause of the breaches was scour, resulting from the above-described current being deflected to and concentrated on the bottom by accumulations of floating driftwood above the dikes. The pressure of the current on the driftwood, being transmitted to the upper parts of the dikes, also contributed to breaching them.

The stream end of Dike 19 A had been destroyed by scour in April, 1894, and was reconstructed in May, 1895, as 4-row dike, with heavy oak piles driven to 26 feet penetrations.

The breached part of Dike 19 B was constructed of white cypress piles, with penetrations of 28 to 30 feet.

I was directed by your letter of July 9 to renew the outer end of Dike 19 A. The high stage of the river, however, did not permit this being done until July 31.

The new work was made 4-row dike with a 3-row "L," 95 feet long. Pine piles were used exclusively and were given penetrations of about 27 feet.

Besides the usual top bracing the pile structure was reenforced at each bent by a double wire strand stay ⅝ or ¾ inch diameter. They were attached to the piles of the front row at the ground and extended to those of the back row at their tops, where, after being tightened by means of tackle and the power capstan of a 64-foot barge, they were made fast.

The work was completed August 12. Its cost was $1,942.99.

GENERAL RESULTS OF IMPROVEMENT WORKS.

Cross sections on the lines of one of the dikes of each group shown on Plates I, II, and III represent the building up of accretions around the dikes since their construction.

The improvements in channel at the same sections, either by enlargement or changed position, are also shown up to the dates thereon indicated.

There is also submitted a longitudinal section of the improved reach of river, showing the depths and slope of water surface for about a five-eighths stage.

The deep hole at the stream end of Dike P resulted from an eddy formed by the meeting at right angles of two currents—that of the main channel normal to the dike and that from behind the towhead opposite and below Jefferson City, flowing parallel to and above the dike. The same feature at Dike No. 34 was produced by somewhat similar causes.

Discharge measurements made about the middle of August with the river about a five-eighths stage, near Ewing boat yard, between the head of Dodds Island and Ferguson Island and in Ferguson Island Chute, showed a loss of about 25 per cent in volume over Osage Chute Dam, and of 11 per cent additional through openings in the accretions between the dam and the head of Ferguson Island. To these diversions of flow are to be attributed a noticeable shrinkage in channel areas and reduction in depth at the two lower localities.

PLANT.

During and after the June rise the floating plant was laid up at the bluffs, about 1 mile below the Ewing boat yard.

The roofs of construction quarter-boats Nos. 3 and 6 were repaired, also the calking of three 100-foot barges, four 64-foot barges, hydraulic grader No. 8, carrrying a Cram steam hammer, and the division office boat.

A burnt sheet of the steam tender *Atalanta* boiler was replaced by part of a new ring, and the boiler tested to 186 pounds hydrostatic pressure. One of her cranks, which had worked loose, was shimmed and secured by three steel pins. The boat was also painted.

The old heater of the steam tender *Melusina* was replaced by a copper-coil heater from one of the pile sinkers and her furnace liners repaired. Some changes were also made in the roof of the boat, with a view to reducing the high temperature in the engine room.

Slight repairs were also made to the Vulcan Nasmyth steam drivers, and the office boat launched.

The total expenditures on account of plant amounted to $3,470.85, of which $500.37 were for repairs.

The work of improving the Missouri River on Osage Division and such plant and property pertaining to it as were not required for carrying on construction works at up-river points were, by your direction, transferred to Mr. S. Waters Fox, Division Engineer, on September 6.

Very respectfully, your obedient servant,

SAM'L H. YONGE, *Division Engineer.*

Lieut. Col. AMOS STICKNEY,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

APPENDIX I.

ANNUAL REPORT OF MR. S. WATERS FOX, DIVISION ENGINEER—OSAGE DIVISION.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Chamois, Mo., June 30, 1897.

COLONEL: I have the honor to transmit herewith a report of the operations under my charge on the Osage Division during the period from September 6 to the end of the fiscal year of 1897. On the 24th of August you notified me of the assignment to my charge of the work continuing the improvement in Osage Division of first reach. The transfer was completed September 6, and thereafter operations were conducted under my supervision. The following illustrations accompany the report:

A map (Pl. I) of the river from a point about 1 mile below Claysville, Mo., to Isbell Station, Mo., as developed from the regular annual fall survey of October, 1896, showing proposed lines of rectification, the location and character of improvement works completed, in progress of construction, and proposed; also cross sections of the river at intervals of about 1,000 feet, and steamboat channels.

One map (Pl. II) of the river between Dikes 17 and 36, showing proposed change of plan for junction of Osage and Missouri rivers.

One drawing (Pl. III) showing in cross section the proposed cut through Osage Point as approved.

One drawing (Pl. IV) showing in cross section the arrangement of Dike 19½ A as first planned and approved.

Four photographic views (Pls. V to VIII) showing dikes in process of construction and completed.

One hydrographic chart (Pl. IX) showing the position of a sheer dike above Dike 29 A and the local changes in conditions of flow produced by it.

The operations comprised the construction of new dike; the extension, repairs, alteration, and removal of old dikes; revetment repairs; procuring construction materials; surveying; care and repair of plant, and the usual miscellaneous, incidental, and office work. The work was done under an allotment of $164,000 from the appropriation of June 3, 1896, for continuing the systematic improvement in first reach, and in accordance with a project dated September 30 and approved by you under date of October 2. This project was based upon yours of August 18, which was approved by the Chief of Engineers, United States Army. In brief it provided in detail for the prosecution of the new plan for a junction of the Osage and Missouri rivers in the vicinity of Cote Sans Dessein, and conditionally for the following work: The degrading of the outer end of Dike 19 A; the protection of the shore end of Dike 23; the construction of a sheer dike above Dike 29 A and the reenforcement of the bracing on the latter structure; the restoration of the outer ends of Dikes 34, 35, and 36 to the proposed line of rectification, and the construction of a new dike, 37 B, across Bear Island Chute at the head of the island. The total expenditure during the year was $58,939.46, as shown in Appendix, Exhibit H.

NEW JUNCTION OF OSAGE AND MISSOURI RIVERS.

Scheme.—The accompanying map (Pl. II), with its explanatory notes, shows so clearly the general scheme, that I beg leave to refer to it and the following extract from a resolution of the Missouri River Commission passed July 17, 1896, for a full presentation of the matter:

"The effect of the work done in the vicinity of Dodds Island has been to produce a difference in level of water surface in the Missouri River and the Osage at the head of this island, when the Osage is not in flood, of about 3 feet. In consequence of this difference of level the dikes above the head and at the foot of this island have been breached a number of times, and the low dam extending out from the head of the island has required frequent repairs and extensions. It is believed that this difference in water level on the opposite sides of the island would always be a source of danger to the works, and by their breaching cause a filling up of the channel of the Missouri River. These effects have become more and more apparent as the dike work has progressed toward and below the foot of Dodds Island. Moreover, the low-water flow of the Osage, being extremely small in volume, it is believed could not maintain a navigable channel through the chute behind the island without extensive construction works for reducing the cross-sectional area. For these reasons provision should be made at an early date for bringing the Osage into the Missouri at its natural mouth at the head of Dodds Island and for closing the chute behind that island."

The order in which it was proposed to carry on the work was as follows: The degrading of Dikes 25 and 26 and the closing of the breach at the shore end of Dike 19 B to be commenced on receipt of authority; the two-row pile work in Dike 19½ A was next in order, but as the foot mattress did not extend above the upper row of piles its construction was to be deferred until the purchase of the land had been made; the cut through Osage Point having been made and Dike 19½ A completed, that portion of 19 B lying within the limits of the proposed low-water way was to be removed; then the in-shore portion of that dike, the Osage Dam, and Osage Point revetment were to be degraded; then, if necessary, to cause a flow through the new cut, a ditch 15 feet wide was to be cut through the accretions below 19 B on the proposed line; the construction of Dikes 32, 33, and 33 B was to await the development of the proposed low-water channel way through Osage Point to a junction on the proposed line with the Missouri River.

Degrading Dike 25.—Because a favorable stage of river did not sooner occur the work of lowering this dike, and also No. 26, was deferred until early in December. To have lowered them to the extent proposed in the project would have involved a very large expense in the removal and excavation of extensive rack heaps and accretions which had formed, and accordingly the dikes were lowered as far as possible without excavation. Between the 3d and the 6th of December the outer 42 feet of

Dike 25 and 50 feet of its trail were cut down to an elevation of 2.2 feet above standard low water, and rebraced, and a large drift pile 60 feet from the outer end of the dike was fired.

Degrading Dike 26.—The lowering of the grade of this dike was accomplished as far as practicable between the 4th and 8th of December. The braces on the outer 200 feet of the main dike and the trail were removed. The outer 32 feet of the dike and 48 feet of the trail were cut down to grade and rebraced.

Dike 19 B.—The construction of 208 linear feet of two-row work to close the gap at the shore end of Dike 19 B was commenced October 13 and completed on the 23d of the same month. A photographic view of this work is shown on the accompanying Pl. V. The work of removal of that portion of this dike and its accumulated drift which lies within the proposed low-water channel way of the Osage River was begun on December 3 and continued throughout that month, and at times during January and February as the weather and stage of river permitted. The degrading of the same structure beyond the limits of the low water and within those of the high-water lines was also begun at the same time. The dike is a three-row structure built in 1895; the original penetration of the piles was 25 feet, which had subsequently been increased by the accretions to an average of about 30 feet. Of the 1,550 linear feet of the dike which lies within the proposed Osage River channel, 682 linear feet were within the limits of the low-water way and were to be entirely removed, and the remaining length to be degraded to a slope from standard low water to 3 or 4 feet above it, between the limits of the right-bank low-water way and the line of high-water flow. The pulling of the piles was undertaken with two pairs of shears, each rigged for pull with a horse capstan of six 6-inch manila lines. Some of the piles were extremely difficult to pull, and several broke in two under practically a straight strain. The total number of piles got out was 82. The wales and braces were removed from the entire 1,550 feet of the dike and the piles within the limits of the proposed high and low water way cut down as close to the required grade as possible. The drift within the lines of low-water flow, which covered an area of about 2¼ acres from 2 to 10 feet deep, was fired and about three-fourths of it reduced to ashes. Coal oil was liberally used to assist in the firing, but some of the larger pieces were so water-soaked that their burning was difficult. Dynamite was used to loosen large pieces of the drift, so that it might be piled up in heaps to facilitate burning.

Cut through Osage Point.—The proposed cut through Osage Point as approved is shown in cross section on the accompanying Pl. III. In accordance with instructions contained in your letter of September 10, negotiations were at once begun with the owner for the purchase by the United States of all the land on Osage Point lying to the eastward of the left bank of the proposed waterway, and as it was thought that that could be quickly consummated, arrangements were made, by your direction, for hiring and promptly assembling on the ground the necessary excavating plant and operating crews. But as it was not until the latter part of May—some eight months later—that the purchase was finally completed, and as ownership by the United States was an essential preliminary, no work was done on the cut.

Dike 19¼ A.—This structure as originally designed and approved is shown in accompanying Pl. IV. It is intended to constitute the left bank of the proposed waterway of the Osage River from its intersection with the main right bank of the Missouri River on Osage Point to a point a short distance beyond its intersection with Dike 19 B. It was to consist of an embankment of earth built to an elevation of 5 feet above standard high water and reinforced on the lower or Osage River side by a 2-row pile structure, the latter to extend from Dike 19 B to the right bank of Osage Dam Chute, at an elevation of 7 feet above standard low water. On October 16, by your direction, work on the pile structure was commenced, it having been decided to change the arrangement so that that part of the dike would lie on the upper or Missouri River side of the embankment. It was completed on the 28th of November. The accompanying photographic views, Pls. V and VI, show the dike as it then was. Two hundred and sixty-six piles were driven in the dike in bents of 2, spaced 10 feet each way, to an average penetration of 26.8 feet, and 9 for temporary anchorage. One thousand three hundred and ninety-three linear feet, or 59,380 square feet, of foot mattress was woven. The mat was 60 feet wide within the limits of the waterway of Osage Dam Chute and 30 feet wide on the dry bar; the lower edge of it was flush with the lower row of piles. A pole curtain was put on that portion of the dike in the waterway. The system of bracing shown in cross section on Pl. IV was followed. The wales were 6 by 8 inch lumber on the upper row and 5 by 8 inch on the lower row, and were bolted to the piles with ¾-inch screw bolts. The direct braces—two pieces of 4 by 8 inch—embraced the piles and were bolted to them with ¾-inch screw bolts. They rested on the top wales (upper and lower row) and were gained on them 1 inch to take a thrust. The drop braces were made of two pieces of 4 by 6 inch stuff, separated at the lower end by a 3-foot block so as to embrace the pile at the river bottom. A sling of four parts of ⅜-inch wire strand passed around the pile and through the brace at the separating block, so that when the brace was in place the sling firmly held it to the pile. The top end of the brace was cut in under the direct brace and against the wale and then fastened to the pile with a ⅝-inch screw bolt.

A rise of 11 feet in river occurred in January, and during the flood the flow through the Osage Dam chute was several times reversed according to the relative stages of the two rivers. After the rise subsided, it was found that 310 linear feet of the curtain on the dike had been damaged and required renewal. This was done. During the April rise a breach developed in this dike beginning about 680 feet from its intersection with Dike 19 B, and a waterway 75 feet wide and 8 to 10 feet deep was scoured around the west end of the structure. A pile of rock ballast, stored on the bar last season, prevented the gap from enlarging. Large quantities of driftwood had accumulated along the entire line of the dike, being especially heavy between Dike 19 B and the breach. An examination of the bottom in the breach showed the foot mattress to be intact. The upstream edge of it apparently had not moved; but on the line of the piling the observed depths showed the mat to be from 8 to 15 feet lower than when it was put there, while just below the lower edge there was 39 feet of water. Undoubtedly the breach was caused by scour due to overpour, as the mattress does not extend beyond the lower row of piles. Several bents of the structure that lodged below showed both piles and the braces unbroken. Instructions were given to close the breach and extend the dike to a junction with 19 A, the old work to be reenforced on the upstream side with a row of piles, extending 5 feet above standard low water, and placed 15 feet above the upper row of the old work. Operations were begun on May 22 and by June 25 the dike was practically completed.

Because of the accumulation of drift the reenforce pile from Dike 19 B for 35 bents across the bar was driven alongside of the upper pile of the old structure. The part of the extension on the right shore bar for 17 bents from the junction with Dike 19 A was made two-row work. In all, 297 piles were driven, of which 278 were in dike and the balance for temporary anchorage. The average penetration of piles in the dike was 26.3 feet; 942 linear feet, or 41,680 square feet, of foot mattress was made; 917.57 cubic yards of rock ballast was expended on the foot mattress; 690 feet of the dike was curtained. The system of bracing used is shown in the accompanying photograph (Pl. VII). The drop braces are built of two pieces of 6 by 8 inch long-leaved pine; they are held in compression by the companion tension member of two parts of ¾-inch strand; the latter member was also designed to strengthen the upper pile against counter strains that would arise from a flow out of the Osage River, in the event that that occurred before the embankment was built. The only other distinctive feature of the system of bracing was in the filling blocks introduced at the pile on every direct and open drop brace to aid the bolt that goes through the pile in transmitting strain. The cost of the foregoing work is shown in detail in the Appendix, Exhibit I.

OTHER DIKE WORK.

Sheer Dike 29 A.—The location of Dike 29 A is such that it has been particularly exposed to driftwood and ice, and under the conditions likely to be imposed when the new junction of the Osage and Missouri rivers shall have been accomplished, the severity and frequency of such attacks would be largely increased. With a view of protecting the main or cross dike, an experimental device, a sheer dike, was built above it, October 23 to 30. The sheer dike consists of a row of cluster piles extending from the outer end of the main dike upstream to the bank, on a line that makes an angle of 60 degrees with that of the dike. The clusters are spaced 25 feet apart and consist each of 3 piles so driven that the points of their penetration into the bottom form approximately an equilateral triangle, the sides of which are 5 feet. The tops of the piles in each cluster are brought together and lashed with ¾-nich strand. In all, 78 piles in 26 clusters of 3 each were driven. The piles were not driven to a definite grade, but a straight line that fairly averages the tops is 12¼ feet above standard low water at the bank, and 7 feet above at the outer end of the dike. The average penetration attained was 21.6 feet. The location of the sheer with reference to the main or cross dike and also the development of a series of observations for local changes of bottom and velocity and direction of flow, taken with a view of studying the action of the sheer, are shown on the accompanying chart (Pl. IX). The first effects were a deepening by scour along the line of the sheer and a training effect on the direction of the current. The latter at times, and particularly during the winter when the inclosed space behind the sheer was frozen over, was very marked. Later on there was a marked filling back over the entire bottom covered by the observations (except close to shore and near the upper end of the sheer, where there appeared to be a scour), and also a much less marked training effect on the current. Its usefulness as a protection to the main dike against driftwood and ice was fully demonstrated. Although more or less damage was sustained by the sheer, none was done to the main dike; indeed, practically no driftwood or ice reached the latter structure and none lodged on the former. During a heavy run of ice in January, and while the Osage River was discharging over the dam, the sheer dike was subjected to a very severe treatment resulting in three of the piles being broken and the lashings were stripped off of seven pile clusters. It is very probable that the main dike then escaped serious injury. The cost of the foregoing work is shown in detail in the Appendix, Exhibit A.

Degrading Dike 29 A.—Instead of simply reenforcing the bracing on this dike as provided for in the project by your direction, the grade of the outer 300 feet of this structure was lowered to an elevation of 2.6 feet above standard low water at the outer end and 5.4 feet above at the inshore end. This work was commenced November 25 and completed December 3.

Dike 34.—The extension of this dike 191 feet to the proposed line of rectification was begun October 31 and completed November 24. Nineteen bents of 2-row was built. The inner 14 bents were spaced 10 feet each way; in the other 5 bents the rows were 20 feet apart.

Dike 35.—The extension of this dike 247 feet to the proposed line of rectification was begun November 2 and completed on the 25th of the same month. Twenty-five bents of 2-row work, the rows 20 feet apart, was built.

Dike 36.—A breach 109 feet in length in the old dike, near the outer end, that occurred sometime in December, 1895, was repaired and the outer 7 bents reenforced. Eleven bents of 2-row was built to close the gap.

In the three dikes last referred to 185 piles, in all, were driven, of which 19 were for temporary anchorage; 682 linear feet, or 36,530 square feet, of foot mattress was made; 502.82 cubic yards of rock ballast was expended, and 490 linear feet of pole curtain built.

All of the new work was built to the grade of the old work at its junction therewith, and 34 and 35 were carried out on uniform grades to an elevation at their outer ends of 2.4 feet above standard low water. In bracing 34 and 36 the usual 6 by 8 inch wales, 4 by 8 inch open direct, and 4 by 6 inch open drop braces were used, the latter fastened at the top of the upstream pile and to the downstream pile at the bottom. A portion of 35 was braced in the same manner, but on account of some foot mattress, which, during the progress of work had broken loose from its anchorage and folded up against the piles, it was not possible to use the open drop braces on 16 of the bents, and ties made of four parts of ¾-inch strand were substituted. The tie extended from the bottom of the river on the pile in the upper row to the top of the pile in the lower row.

Dike 29 B.—On the 10th of April a small breach occurred at the root of this structure, which on the 15th had enlarged to 15 feet wide and 13 feet deep. Four days' work with a small force closed the breach on the 20th, 120 cubic yards of rock being used and 20 linear feet of cross curtain placed.

The cost of the foregoing work is shown in detail in the Appendix, Exhibit B.

REVETMENT REPAIRS.

Murrays Bend.—A caving in the upper bank-work of this revetment in detached places over a reach of about 410 feet and in the locality of 3,890 feet from the head of the revetment was reported September 16. Temporary repairs were made by filling in on the shore side of the old anchor piles with fascines of brush and rock to a depth of about 30 inches, 60 cords of brush and 85 cubic yards of rock being expended. In October another series of small breaks developed in the upper bank-work over a reach of 220 feet in the locality of 420 feet below the lower end of those above referred to. They also were temporarily repaired, and in the same manner as above described, using 25 cords of brush and 49.3 cubic yards of rock. Again in December two small breaks aggregating about 100 feet in length developed in the upper work just below those above reported, and they were repaired in the same manner, requiring an expenditure of 10 cords of brush and 20 cubic yards of rock. The cost of these repairs was $766.49, as shown in detail in the Appendix, Exhibit C.

DAMAGES TO WORKS.

Beginning with March 22 at a stage of 4.3 feet above standard low water and covering a period of sixty-one days to May 21, when it had returned to the same stage, the river may be said to have been in flood. The highest stage attained was 16.2 feet above standard low water on April 30. During the period referred to the Osage River was not contributing any to the discharge of the Missouri. After the flood had subsided, an examination disclosed the following:

Dike P.—The outer 215 feet of this dike was four-row work, carrying a T head, having arms of 40 feet and 70 feet up and down stream, respectively. The upper arm was taken out during the June, 1896, high water, and 165 feet of the dike with the trail had been destroyed since April 7 of this year. A portion of the wreckage, lodged on Dike Q, showed some of the piles whole, which would indicate scour; others, however, were broken off 10 to 15 feet above the point. On May 7 the depth of water over the line of the break was 22 to 27 feet, and at the present end of the dike, 15 feet.

Dike 19 A.—The outer 289 feet of this dike was four-row work carrying a three-row trail 100 feet long. One hundred and twenty-nine feet of the dike and all of the trail had been carried out. At the present end of the dike the water was 26 feet deep, increasing to 32 to 40 feet farther out.

Dike 19½ A.—The injuries sustained by this structure have been already reported under a previous chapter.

Dike 19 B.—The outer 270 feet of this dike and 70 feet of trail constructed in June, 1895, was built of white-oak piles in three-row work. The outer 80 feet of the dike and the upper 20 feet of the trail had been scoured out. The depths of water at the present end of the dike and at the upper end of the trail were, respectively, 18 and 26 feet, while in the breach it was from 26 to 35 feet.

Dike 30.—This dike was intact, but the mattress constructed across the bar had settled, and the accretions were being cut away.

Dike 32.—The outer 177 feet of this dike with its entire T-head 120 feet long, all three-row work, had been swept away by scour and pressure from drift. The depth of water at the present end was 16 feet, with 17 to 20 feet farther out.

Dike 29 A.—The upper 18 clusters of piles in the sheer dike above this structure were in good condition. The lower 8 clusters, some of which were under water, appear to be more or less damaged.

Dike 29 B.—The injury sustained by this structure has been already reported under a previous chapter.

Later on—about the 22d or 23d of May—a breach 200 feet in length developed in Dike I. The south end of the breach is about 300 feet inshore from the stream end of the dike. Soundings taken in the breach on May 25 showed from 17 to 28 feet of water. During the January flood the new work of Dike 35 was breached. Ten bents were carried away.

PROCURING CONSTRUCTION MATERIALS.

The brush, poles, and rock used during the year were procured by hired labor. Other materials—piling, lumber, strand, etc.—were purchased in the usual manner.

Brush.—In October a small brush party procured 76.4 cords of brush from the accretions at the mouth of Rising Creek and was then disbanded. With the exception of 10 cords of curtain poles cut on the 31st of May, all of the brush and poles used prior to June were supplied by a party sent out from the lower division. On the first day of June a small party began cutting brush and poles, and by the 12th of that month were disbanded, having procured 140.4 cords of brush and 81.75 cords of poles. One thousand one hundred and ninety-four and nine-tenths cords of brush and 100.6 of poles were received from the lower division party. The cost of this material is shown in the Appendix, Exhibit D.

Rock.—A quarry site was found in the bluff at Osage Point, and the usual quarry privileges secured in consideration of the payment of 1½ cents per cubic yard of rock ballast removed. A force was organized and equipped and began work there on October 16. The quarry force was somewhat reduced during the month of November, but operations were continuous until December 23, when the force was disbanded. Eight thousand two hundred and seventy-nine and nine-tenths cubic yards (estimated) of rock ballast was produced. Of this amount 1,985.9 cubic yards was hauled out of the quarry either to point of expenditure or storage; the balance of it was left at the quarry. The cost of the work is shown in detail in the Appendix, Exhibit E.

TOWBOAT SERVICE.

The towboat service was performed by the steam tenders *Melusina*, *Sabrina*, and *Arethusa*. They were in service ninety, thirty-two, and forty-one days respectively. Up to the time when the *Melusina* was laid up for the winter (December 5), she almost exclusively performed the service. She was not again put in commission, the *Arethusa* or the *Sabrina*, or both, doing the necessary work, as was found to be most advantageous.

PLANT.

Care and repair of plant.—No extensive repair was done during the year. A number of broken way-logs and worn out butter boards in storage and launching ways were replaced, putting them in shape to receive the hulls. The United States steamers *Alert* and *Golden Gate* arrived at the Ewing boat yard on the 14th and 18th of October, respectively, and were subsequently laid up for the winter. Steam was raised on the United States steamer *Alert* on the 19th of October, and the wash of her wheel utilized to clear away the accretions that had formed at the foot of the launching ways. She was thus employed for three days. A portion of the accretions that could not be so reached was removed by means of a jet of water supplied from Pile Sinker No. 6. Between November 9 and December 4 the following hulls were pulled out and placed on the ways, as the pieces were thrown out of service: Sixteen 100-foot barges, eight 64-foot barges (3 of them with cabin quarters), 1 Vulcan pile driver, 1 large construction-quarter boat, 1 pile sinker, steam tender *Melusina*, United States steamers *Alert* and *Golden Gate* and 11 punts. Shores were set under all rakes, decks and holds cleaned, and machinery properly laid up for the winter. Nine 100-foot barges and three 64-foot barges were left in the river, as they were totally unserviceable and beyond repair. They were securely tied up below the stream ends of Dikes 9, 10, 11, and 19 A, but all of them sank during the winter excepting the four 100-foot barges moored at Dike 19 A.

The work of preparing floating plant for early service in the spring was commenced by a small party February 18. The following hulls were repaired, calked, and launched by March 29: Sixteen 100-foot barges, eight 64-foot barges, three of them with cabin quarters, one pile driver, one large construction quarter-boat, machine boat, steam tender *Melusina*, United States steamers *Alert* and *Golden Gate*, and eleven punts. The repairs made to the hulls were comparatively slight. Rotten spots in the gunwales and bottoms of the barges, and other hulls, were cut out and engraven pieces put in; decks were pitched; timber heads and kevils renewed, where needed; and the roof of construction quarter-boat No. 6 patched with new strips of canvas and painted, and her guards thoroughly overhauled.

There was a general overhauling and repair of the piping, wheels, rudder, etc., of steam tender *Melusina*, and the machinery and all other pieces put in good working order. Current repairs incident to the wear and tear of service were done from time to time as the need developed.

By your direction United States steamers *Alert* and *Golden Gate* were placed in commission and cleared from Ewing boat-yard on the morning of April 23 for Vicksburg, Miss., where they were to be assigned for duty distributing supplies and affording relief to flood sufferers. At the time orders for placing them in commission were received (April 20), both steamers were in a dismantled condition and in need of some repairs. Measures were at once taken for the organization of a crew for each steamer, and as large a force of men as could be advantageously employed were at once put to work and continuously employed until the steamers were turned over to their officers ready for service. After being relieved both steamers returned to Ewing boat yard and were laid up. The *Alert* arrived there May 19, the *Golden Gate* four days later.

The repairs made to the yard, plant, and appliances were slight and inexpensive. The ways were strengthened at several points, where they showed signs of weakness from decay, by putting in extra braces and shores; the steam-pulling winches and apparatus were overhauled several times. Besides the above, the stock of small tools, pulling blocks, wheelbarrows, quarry tools, bilge pumps, etc., was gone over and, such of them as needed it repaired.

Unserviceable property.—Such pieces of unserviceable property as could be readily transported were sent to Gasconade, January 6, for inspection and condemnation.

New plant.—The only new plant made during the year was ten wooden bilge pumps for use on barges and two pairs of shears for pulling piles.

The cost of the above, except an item of $609.90 covering the expense incurred in repairs and other work incident to placing in commission the steamers *Alert* and *Golden Gate*, is shown in the Appendix, Exhibit F.

SURVEYS.

Besides the usual surveying incident to construction work there was the regular fall topographic and hydrographic survey of the division; some special observations, previously referred to, in the vicinity of Dike 29 A, and a special shore-line survey in the vicinity of Dike 16 B. During the month of September a shore-line survey of the reach involved in the project for the new junction of the Osage and Missouri rivers was made, 11 temporary gauges established, and proposed Dikes 32, 33, and 33 B located in the field and soundings taken on their lines. The proposed left bank of Osage River across Osage Point was staked out, a careful survey of the portion of the point east of that line, containing 10.8 acres, was made, and the proposed new waterway for the Osage River was cross sectioned at intervals of 100 feet. The temporary gauges, above referred to, were located as follows: On Dikes 16 B, 19 A, 19 B outer end, 19 B inshore above dam, Osage River below dam, Dikes 25, 27, 29 A, 31, 32 A, and 33 B. They, together with regular gauges at Ewing boat yard, Osage City (railroad bridge), and Bonnots Mill, were regularly read once a week during the period from September 10 to February 13. A chart showing weekly changes in local slopes, as indicated by these records, was prepared. On the 26th of November soundings were taken to show a longitudinal profile of bottom through the same reach. The low-water survey of the division was begun at a point about 1 mile below Claysville, Mo., on the 12th of October, and was completed to Isbell Station, Mo., on the 27th of the same month. Fifty-nine and three-tenths miles of stadia line were run and 147 cross sections of the river made. A map, to a scale of 1 inch=1,000 feet, was developed from the notes. The accompanying map (Pl. I) was traced from a pantograph reduction made in the St. Louis office. Four complete sets of observations for the purpose of determining the local influence of sheer dike above Dike 29 A were taken between the dates of December 12 and June 9, which included the sounding of 15 partial cross sections and taking numerous float observations to show direction and velocity of current. The cross sections are parallel to each other and about 45 feet apart, being equally spaced between the upper end of the sheer dike and the main dike. They extend from the left bank out beyond the steamboat channel. Two cross sections on line of sheer dike were taken October 5 and 25, the former before the sheer was constructed, the latter during its construction. The results of these observations are shown on the accompanying map (Pl. IX).

The cost of the above in item is shown in Appendix, Exhibit G.

In compliance with instructions contained in your letter dated June 21, 1897, preparations looking to the abandonment of the boat yard at Ewings Landing, Mo., are being made; the Osage and Gasconade divisions will be consolidated, beginning July 1, 1897, and thereafter known as the Gasconade division of first reach.

In closing, I desire to acknowledge the support afforded me by my assistants and the unfailing interest and application to duty exhibited by all employes on the Osage division.

Very respectfully, your obedient servant,

S. WATERS FOX, *Division Engineer.*

Lieut. Col. AMOS STICKNEY,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

List of exhibits forming appendix to foregoing report.

Exhibit A.—Bill of cost of dike construction.
B.—Bill of cost of dike repairs, etc.
C.—Bill of cost of revetment repairs, Murrays Bend.
D.—Bill of expenditures on account of procuring willow brush.
E.—Bill of expenditures on account of procuring rock ballast.
F.—Expenditures on account of plant during fiscal year.
G.—Bill of cost of survey.
H.—Statement of liabilities incurred during fiscal year.
I.—Consolidated bill of expenditures on account of new mouth of Osage River.

EXHIBIT A.

Bill of cost of new dike work constructed during fiscal year ending June 30, 1897.

Classification.	Dike 19½ A (1353 linear ft. new work).		Dike 29 A (sheer dike).	
	Quantity.	Cost.	Quantity.	Cost.
353 piling, as follows:				
Pine (344) .... linear feet..	8,814	$1,342.90	3,076	$481 80
Cottonwood (9) .... do....	288	23.10	....	....
Long-leaf yellow pine .... feet B. M..	33,413	719.95	....	....
Rock ballast delivered on barges .... cubic yards..	561	503.91	....	....
Brush and poles delivered on barges .... cords..	454.7	1,151.84	....	....
5,522 pounds ⅝-inch strand for mooring and lashing, pounds	5,238	201.66	284	10.93
3,812 pounds fastenings, screw, drift, and eye bolts, etc .... pounds..	3,737	85.63	75	1.64
Labor, as follows:				
Pile driving	....	789.90	....	86.78
Weaving and ballasting	....	605.37	....	....
Bracing	....	336.44	....	....
Curtaining and lashing	....	35.29	....	28.83
Subsistence (4,624 meals) .... number..	4,327	581.98	297	39.94
Fuel, coal (790 bushels) .... bushels..	655	102.25	135	21.07
Steamboat service, towing supplies, construction materials, etc	....	54.72	....	22.86
Total	....	6,534.94	....	693.85

EXHIBIT B.

Consolidated bill of dike repairs, reenforcement, removal, extensions, and alterations made during the fiscal year ending June 30, 1897.

Classification.	Dike 19½A.—Reenforcement repairs and extension (1,695 linear feet).		Dike 19B.—Closing breach (208 linear feet).		Dike 29A.—Degrading and bracing (337 feet).		Dike 25.—Degrading and bracing (92 feet).		Dike 26.—Degrading and bracing (80 feet).	
	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.
540 piling, as follows:										
Pine (492) ....linear feet..	11,796	$1,938.54	1,554	$244.80						
White oak (45)............do....	700	103.39								
81,942 feet B. M. long-leaf yellow pine lumber...........feet B. M..	57,683	1,276.04	4,156	90.44	443	$9.56				
Fastenings, bolts, washers, etc.lbs..	9,855	281.67	460	10.28	891	17.63	208	$5.31	166	$3.31
Strand wire ....do..	22,399	843.47	608	23.41						
Brush and poles delivered on work, cords	429.8	1,353.20	67.1	171.09	8	22.44				
Rock delivered on work..cu. yards..	1,042.57	1,659.04	88	72.84						
Coal ....bushels..	735	111.13	80	12.45						
Supplies, waste, oils, etc		13.56								
Labor:										
Pile driving		557.97		70.43						
Mattress weaving and sinking..		625.06		89.28						
Bracing...........................		959.80		29.10		186.74		47.19		93.30
Curtaining		95.95		12.52		9.97				
Subsistence..................meals..	5,877	716.93	484	65.09	498	66.98	120	16.14	243	32.68
Towage plant, material, supplies, and construction parties..........		125.49		9.81		17.96				
Totals		10,661.24		901.04		331.28		68.64		129.29

Classification.	Dike 29B.—Repairing shore end (cost in item).	Dike 34.—Constructing extension (191 feet).		Dike 35.—Constructing extension (247 feet).		Dike 36.—Closing breach (109 feet); reenforcing outer end (69 feet).		Dike 19B.—Removing dike, clearing proposed channel, degrading and bracing.		Dike 29A.—Relashing sheer dike.	
		Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.
540 piling, as follows:											
Pine (492)..linear feet..		1,942	$310.40	4,370	$721.92	1,108	$174.56				
White oak (45)...do....		100	15.14	1,126	170.48						
Cottonwood (3) ..do....		64	5.13			32	2.57				
81,942 feet B. M. long leaf yellow pine lumber, feet B. M.................		6,964	153.18	10,072	232.88	2,624	56.13				
Fastenings, bolts, washers, etc..............pounds..		1,522	63.54	1,885	70.47	840	31.77			57	$1.24
Strand wire..........do....		557	20.29	4,220	162.47	432	16.63			108	2.97
Brush and poles delivered on work...........cords..		37.16	95.12	175.69	445.53	5	14.02				
Rock delivered on work, cubic yards		141.15	116.03	361.67	297,29						
Coal ....bushels..		105	16.39	210	32.78	60	9.37				
Supplies, waste, oils, etc....									$151.48		
Labor:											
Pile driving			81.43		186,04		43.92				
Mattress weaving and sinking			136.73		238.77						
Bracing..................			175.81		170.54		58.81				
Curtaining..............			6.06		17.20		13.00				
Miscellaneous..........	$62.06								1,357.10		20.23
Subsistence		1,104	148.49	1,645	221.24	303	40.76	3,124	418.81	54	7.20
Towage plant, material, supplies, and construction parties			40.83		17.97		4.89		6.53		
Totals................	62.06		1,384.52		2,985.58		466.43		1,933.92		31.64

EXHIBIT C.

Bill of cost of revetment repairs in Murrays Bend made during the fiscal year ending June 30, 1897.

Classification and extent.	Cost in item.
Materials:	
95 cords of brush, at $2.5197 per cord	$239.37
90 cubic yards of rock, at $1.432 per cubic yard	128.88
44.3 cubic yards of rock, at $0.872 per cubic yard	38.63
20 cubic yards of rock, at $0.822 per cubic yard	16.44
528 pounds of wire No. 10, at $0.0185 per pound	9.77
Labor	174.23
Subsistence	9.42
Towage of material, plant, and supplies	149.75
Total cost	766.49

EXHIBIT D.

Bill of expenditures on account of procuring willow brush during the fiscal year ending June 30, 1897.

Classification.	Quantity.	Average cost.	Cost in item.
Brush privilege ... cords	305.65	$0.0268	$8.19
Binding wire ... pounds	326	.0185	6.03
Labor and subsistence: Cutting and barging *a* ... cords	1,601.15	1.7588	2,816.17
Total cost on barges		1.7677	2,830.39

a 1,295.5 cords of brush received from Gasconade Division is included in this item.

EXHIBIT E.

Bill of expenditures on account of procuring rock ballast during the fiscal year ending June 30, 1897.

Classification.	Osage Point Quarry.		
	Quantity.	Average cost per cubic yard.	Cost in item.
Quarry privilege ... cubic yards	1,985.9	$0.015	$19.79
Quarry supplies, explosives, fuse, etc		.0629	521.10
Labor and subsistence:			
Quarrying ... cubic yards	8,280	.5669	4,694.62
Hauling to point of expenditure ... do	1,889	.8575	1,619.95
Barging ... do	96.9	.4940	47.87
Total			6,903.33
Average cost per cubic yard:			
Loaded on barges		1.1388	
Hauled to point of expenditure		1.5019	

EXHIBIT F.

Bill of expenditure on account of plant during the fiscal year ending June 30, 1897.

Classification.	Labor.	Subsistence.	Supplies.	Materials.	Cost per item.
Care of plant:					
Watching	$3,017.93	$1,062.93	$19.78	....	$4,100.64
Pulling out 42 hulls	1,067.70	264.83	145.65	....	1,478.18
Launching 42 hulls	496.62	137.33	78.00	....	711.95
Cleaning, sorting, and storing	2,560.56	717.87	38.06	....	3,316.49
Steamboat service	....	....	....	....	395.62
Total	7,142.81	2,182.96	281.49	....	10,002.58
Repairs and alterations:					
Yard plant	469.51	107.87	....	$34.19	611.57
Floating plant	1,488.23	298.27	....	349.18	2,135.68
Current miscellaneous	465.46	92.53	....	33.63	591.62
Total	2,423.20	498.67	....	417.00	3,338.87
New plant constructed:					
Small pile drivers (2)	65.75	12.40	....	29.31	107.46
Bilge pumps (10)	19.06	3.07	....	18.41	40.54
Total	84.81	15.47	....	47.72	148.00
New plant purchased:					
Lanterns, brooms, tin cups, faucets, etc	....	....	....	....	23.43
Water gauge, lubricators, paint brushes, shovels, augers, grindstones, files, etc	....	....	....	....	68.72
Rope	....	....	....	....	509.79
Total	....	....	....	....	601.94
Grand total	9,650.82	2,697.10	281.49	464.72	14,091.69

EXHIBIT G.

Bill of cost of survey work done during the fiscal year ending June 30, 1897.

Classification.	Cost in item.
Labor	$1,986.86
Subsistence	334.44
Towage	200.47
Supplies	32.04
Total cost	2,553.81

EXHIBIT H.

Statement of liabilities incurred under suballotment for systematic improvement in first reach on account of improvement in Osage Division for each month of the fiscal year ending June 30, 1897.

Month.	Labor.		Construction materials.	Plant materials.	Plant purchased.	Subsistence stores.	Supplies.	Sundries.	Totals each month.
	Administration.	All other items.							
September	$291.40	$1,704.78	....	....	....	$276.80	$8.23	$72.70	$2,353.86
October	764.37	5,036.38	$890.11	$9.09	$35.72	1,004.58	2,013.51	5.80	9,759.56
November	1,064.07	7,996.55	3,010.95	45.00	....	902.87	440.11	134.80	13,494.35
December	995.17	3,971.36	4,205.52	64.06	44.77	1,171.03	171.70	256.70	10,880.31
January	990.57	1,516.97	....	5.26	2.26	204.41	18.48	54.85	2,792.80
February	992.01	1,889.29	....	152.49	707.91	365.61	71.60	27.68	4,206.59
March	382.27	2,867.52	....	46.17	6.75	714.08	129.69	158.15	4,004.63
April	399.02	1,325.54	....	....	1.08	484.30	299.30	11.05	2,520.29
May	416.09	2,681.18	....	8.25	67.86	291.69	....	12.85	3,477.92
June	554.45	4,126.33	8.19	10.95	....	691.43	....	57.80	5,449.15
Total	6,849.42	32,815.85	8,114.77	341.27	866.35	6,106.80	3,152.62	692.38	58,939.46

Grand total of liabilities incurred during fiscal year on account of suballotment for systematic improvement, first reach	$58,939.46
Add value of construction materials and supplies on hand September 6, 1896	13,453.11
Total	72,392.57
Deduct value of construction materials and supplies on hand June 30, 1897	14,688.97
Total net expenditure since September 6, 1896, on account improvement Osage Division	57,703.60

EXHIBIT I.

Consolidated bill of expenditures on account of new mouth of Osage River during the fiscal year ending June 30, 1897.

Classification.	Cost in item.
Purchase of land at Osage Point, 10.8 acres, at $100 per acre	$1,080.00
Construction of new work, Dike 19½ A, as shown in Exhibit A	6,534.94
Removal of part of Dike 19 B, clearing proposed channel, degrading and rebracing Dike 19 B, as shown in Exhibit B	1,933.92
Closing breach in Dike 19 B, as shown in Exhibit B	901.04
Reinforcing, extending, and repairing breach in Dike 19½ A, as shown in Exhibit B	10,661.24
Degrading and rebracing Dike 25, as shown in Exhibit B	68.64
Degrading and rebracing Dike 26, as shown in Exhibit B	129.29
Total	21,309.07

APPENDIX J.

ANNUAL REPORT OF MR. S. WATERS FOX, DIVISION ENGINEER, GASCONADE DIVISION.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Chamois, Mo., June 30, 1897.

COLONEL: I have the honor to submit herewith a report of the operations under my charge on the Gasconade Division of the Missouri River for the fiscal year ending June 30, 1897. The following illustrations accompany:

A map (Pl. I) of the river from Isbell Station to Rhineland, as developed from a survey made last fall, showing proposed rectification of shore lines and location and character of improvement works completed, in process of construction, and proposed; also cross sections of the river at intervals of about 1,000 feet, and steamboat channels.

Seventeen plates (Pls. II to XVIII) showing in superimposition low stage cross sections of the river reduced to standard low water, with a view to illustrating progress made toward rectification.

Six photographic views (Pls. XIX to XXIV) showing dike construction parties at work and completed dikes.

Six photographic views (Pls. XXV to XXX) showing a bank-head in various stages of construction and after completion.

Six plates (Pls. XXXI to XXXVI) illustrating, by means of dry and wet contours and float paths and velocities, characteristic features of accretions and bottom, as well as currents, that obtain in Missouri River from permeable dikes.

Three plates (Pls. XXXVII to XXXIX) illustrating, by means of contours and float paths and velocities, the conditions of flow in Chamois Reach prior to the growth of accretion above Dike 28 A′, and the commencement of the construction of the bank-head and after.

One plate (Pl. XL) showing in superimposition a series of partial cross sections inside and outside of outer wall of bank-head, covering a period beginning three days prior to commencement of work on the structure and extending some seventy-one days after it had been practically completed.

One plate (Pl. XLI) showing the plan followed in constructing the bank-head.

The operations of the year comprised revetment and dike construction, as well as the repairing of both kinds of work; the construction of an experimental bank-head, designed as a substitute for revetment; the care and repair of plant; surveying; the preparation of projects and maps, with estimates of cost; examinations and special reports on conditions at several points outside of first reach, and miscellaneous incidental work.

The work was done under an allotment of $164,000 for continuing the systematic improvement in first reach and in accordance with my project of July 13, 1896, as revised from time to time by yourself. The total expenditure during the year was $116,133.14, as shown in Appendix, Exhibit I.

REVETMENT.

Heckmann Island No. 3 (*see Pl. I, K′, L′*).—The earliest and all subsequent projects for the improvement of the Straubs Bend reach contemplated the protection of the south bank of this island by a revetment which should extend around the head of the island and well into Boatwrights Chute, but because of the postponement from time to time of the construction of the group of dikes against Miller Island and the final abandonment of that feature of the original scheme of rectification, the necessity for this work did not sooner develop, or at least it was suffered to wait on more urgent demands. The pool developed by the Bluffton group of dikes finally extended so far down that the closing of Boatwrights Chute (by the extension of Dike XV, and thus incidentally farther extending the pool) and protection of the island became at once necessary.

A small party was put to work on August 6 clearing the bank of timber and undergrowth. Mattress weaving was commenced with one party August 12 and completed September 1. A second party was in service from August 20 to 28. In all, 2,725 linear feet, or 250,674 square feet, of mattress was woven, including one lap. The bank grading followed the weaving, but the trenches for dead-men anchorage were cut in advance with a jet supplied by hydraulic grader. The latter work was commenced August 6, the former six days later. Grading was completed September 24. Two thousand three hundred and twenty-five linear feet of bank, containing 7,530 cubic yards of earth, was graded to an average slope of 1 on 3. The distribution of ballast on mattress and upper bank commenced on August 21 and was completed September 24. The total quantity of rock ballast expended on the revetment was 7,677.2 cubic yards, an average of 2.87 cubic yards per linear foot. The cost of the revetment, as shown in detail in Appendix, Exhibit A, was $16,960.32, or $6.34 per linear foot.

REVETMENT REPAIRS.

The only expense incurred on account of the other revetments on this division was for the maintenance rather than repair of the Chamois Bend revetment. One hundred and ninety-eight dollars and fifty-eight cents was expended in placing 220 cubic yards of quarry chips on two bare spots on the mattress of that work in the locality of 8,500 feet below its head.

The aggregate length of revetment now on the Gasconade division (23 miles of river) is 47,003 linear feet, or 8.9 miles. It is all now in excellent condition. The total cost of the work was $317,941.61, an average of $6.53 per linear foot. The total cost for repairs and maintenance to date is $5,712.82. Some of the work is now four years old, but the major portion of it a little more than two years.

DIKE WORK.

There were only two entirely new dikes built during the year—dikes XI A and XI B, in the middle section of Chamois Bend. These two and a third—Dike XI C—lower down were originally projected to fair up that part of the bend, with revetment above and below, but it was subsequently decided to omit them and revet the bank, making that work continuous. Since the construction of the revetment the thalweg has taken the shape and laid in close to the shore of this bay, and there has been a middle ground in the next lower bay, but until recently, when the bar growth above Dike XXVIII A′ had practically stopped the cross current resulting from longitudinal flow on the upper side of that dike, the development of the left-hand waterway was to some extent held in check. Now a marked crossing has been effected, but with a middle ground still in the bay below; a chute of considerable size has developed to the north of the towhead and the head and south bank of the latter, which has been uncovered by the washing away of the shore bar, is now rapidly yielding to the main flow of the river. It was to correct or ameliorate these conditions that the two dikes referred to were built. Other dike work consisted in extensions, repairs, and alterations of old work.

Dike XI A.—Work on this dike was commenced on June 14 and practically completed June 27. The structure is 240 feet long; the first four bents are two-row and the others three-row work. The piles in the upper row of the other eight bents were reinforced by ten extra piles. The mattress of the revetment was utilized as a foot mattress for the dike as far as the eleventh bent from the shore; from that point a new mattress was made, 30 feet wide above the upper row of piles for four bents and 40 feet from there out a distance 40 feet beyond the end of the dike. The bracing consisted of a single string of 6 by 8 inch long-leaved pine wales fastened with seven-eighths inch screw bolts to the piles in each row near the top and on the upstream side; a direct brace for each bent, made of two pieces of long-leaved pine, 3 by 8 inches, placed so as to embrace all the piles in the bents and fastened to them with three-fourths inch screw bolts; these braces rested on the wales and were gained on them 1 inch to aid the bolt in transmitting a thrust; a tie, formed of two parts of three-fourths inch or four parts of three-eighths inch galvanized strand was put on each bent, extending from the pile in the upper row at the point where it entered the bottom of the river to the top of the pile in the lower row. Instead of the trail or dike head previously used and described in reports, two clusters of three piles each were driven midway between the outer two bents, one cluster 20 feet above the upper row of piles, the other 20 feet below the lower row. The clusters were braced to the dike with 6 by 8 inch timbers.

Dike XI B.—Work on this dike was commenced on June 11, and was nearing completion when an accident occurred that practically stopped further progress. At the time, the night of June 24, the status of the work was as follows, viz, all of the piles, 109 in number, had been driven; the foot mattress woven to bent 37 (being 280 linear feet, or 21,910 square feet) was still afloat; bracing was completed to bent 20, except for fastening strand ties between bents 9 and 20, and wales only had been put on to bent 22. From the bank out the first 12 bents, or 110 linear feet, was two-row work, the balance, 26 bents, three-row. The revetment mattress was utilized as far out as the ninth bent from the shore; from there out a new mat was made, 30 feet wide above the upper row to bent 28, and then 40 feet wide to a point 20 feet beyond the outer end of the dike. The same system of bracing was used on this structure as on dike XI A.

During a storm on the night of June 24, referred to above, an empty 100-foot barge that was moored to the outer end of dike XI A was blown adrift and down onto dike XI B, striking the anchor piles nearly broadside; three of them were broken off, thus allowing the foot mattress, which was anchored to them to buckle down against the dike, with the result that 11 bents, or 33 piles, in the dike, and the greater part of the included foot mattress was taken out. The remaining foot mattress was sunk and a driver put to work to close the breach. Nine dike and 27 anchor piles had been driven when a sudden rise in the river caused a suspension of operations on the 28th. The cost of these dikes is shown in detail in the Appendik, Exhibit B.

Dike XXXII.—The construction of this dike was begun in March, 1896, and twice suspended, the last time on May 18, 1896, on account of high water. It was designed as a four-row dike, 660 feet long with a head 100 feet long. At the time of the last suspension 200 feet of it had been completed, and nearly all the piling had been driven, but no foot mat had been placed nor bracing put on the remaining portion. With the exception of 13 piles which had been carried away during the flood, the dike was in the same condition when work was resumed on the 10th of August. The work, which was completed 16 days later, consisted in driving 8 piles, weaving 563 linear feet, or 39,300 square feet, of foot mattress, and ballasting the same with 500 cubic yards of rock, in bracing 47 bents and curtaining 420 linear feet of dike. The system of bracing used on this dike was that commonly practiced on the division up to that time, the specifications for which were published in last year's report. An innovation was introduced in screening this dike. By your direction the practice which had prevailed of gradually opening up the screen (increasing mesh area) from the bank out was made more marked by omitting the screen entirely from the outer 5 bents, and then in the next 5 bents putting in 1 pole in the first, 2 in the next, 3 in the next, and so on to the fifth bent, from there inshore more rapidly increasing to a condition of juxtaposition in the shore bent. Unfortunately the effect of this change can not be stated, as the curtain was not submerged until the following spring, and soon afterwards that part of the dike was carried away by flood.

Dike XXXIV.—The construction of this dike, like the one next above, was commenced on March 23, 1896, and twice suspended, the last time on May 12, 1896, on account of high water. It was designed as a 3-row dike, 720 feet long, with a 100-foot head. At the time work was resumed, October 5, there was 470 feet of completed dike from the shore out, and 141 piles driven in bents of 3 each from there out. The dike was completed to the project line October 31. The new work involved driving of 8 piles in bents of 2 each, the bracing of 51 bents, the making and ballasting of 580 linear feet or 27,050 square feet of foot mattress, and the curtaining of 44 bents. The systems of bracing and curtaining this dike were the same as those on Dike XXXII.

Dike XXXIII.—The extension of this dike to the project line was commenced October 5 and completed on the last day of that month. Originally the structure was designed as a 4-row high dike, and 1,300 feet of it, from the shore out, had been so built up to the time when work was suspended, May 18, 1896. By your direction the extension, 700 linear feet, was made of 2-row low work. The top of the new work was at an elevation 2¼ feet above standard low water at the outer end and raised on a uniform grade that would run out 7 feet above standard low water at the bank. A few bents of the new work were braced in the same manner as Dikes XI A and XI B, above described, but on the major portion the strand tie was replaced with a timber tie made of two pieces long-leafed pine, 3 by 8 inches, and provided at the lower end with a strap and eyebolt for attaching it to the upper pile at the bottom and a strap and driftbolt for fastening it to the top of the lower pile. An extra brace, making an X with the tie, was used to act in compression. It was made of two pieces of long-leafed pine, 3 by 8 inches, separated by a 3-foot block at the lower end, so as to embrace the lower pile at the bottom, and provided there with a sling of several parts of three-eighths inch strand, so arranged as to jam and take a firm hold on the pile. The upper ends of the brace were cut in at the upper pile just under the direct braces and behind the walls, and were then bolted to the pile with three-fourths inch screw bolts. The curtain was arranged on the same plan as above described in the chapter on Dike XXXII.

Dike XV.—The extension of this dike to the project line was commenced November 2 and completed December 6. Originally it was designed as a 3-row high dike. In the fall of 1893, 200 linear feet of it was built as planned; from that time until November, 1896, no work was done on it. By your direction the extension, 1,280 linear feet, was made in 2-row work. Nearly all of it was built over a dry bar. The system of bracing and curtaining used were the same as those above described as having been used on Dike XXIII. The cost of these works is shown in detail in the Appendix, Exhibit B.

DIKE REPAIR AND ALTERATION.

Dike I B.—The restoration of that part of this dike destroyed by flood in May, 1896, was commenced October 19 and completed November 13. Two hundred and eighty linear feet of dike was rebuilt, by your direction, as 2-row instead of 3, as originally. The system of bracing and curtaining were those used on the extension of Dike XXIII.

Dike I A.—The restoration of that part of this dike destroyed by the flood of May, 1896, was begun October 20 and completed November 11. The 850 linear feet of dike necessary to restore the structure out to the project line was, by your direction, built of 2 instead of 3 rows, as was the original structure. The same method of bracing and curtaining were employed as on Dike I B.

Dike XX A.—The rebuilding of that part of this structure which was destroyed by flood before it had been completed, in May, 1896, was begun on November 2 and completed on the 25th of the same month. By your direction the new work was made of 2-row work instead of 4, as originally planned, and was braced and curtained in the same way as the dikes last referred to. One hundred bents of new work were built, of which 41 were in the outer breach, 52 in the inner, and 7 bents in a dry waterway that had been cut during the flood around the shore end of the dike. On account of the tangled mass of drift and wrecked dike at the north end of the inner breach a jog downstream of 10 bents was made in the new work in order to get a connection with the shore. This part of the work—the jog and several bents either side of it—was subsequently washed out. A portion of the work in the outer breach was also taken out. The repair of both breaks was authorized, and a party began work at the inner one on May 21. By the end of the month that work—13 bents of 3-row work and 3 of 2 rows—was completed, with the exception of some of the bracing, which could not be done on account of the stage of river being too high. The rack heap on the shore had been cleared away to such an extent that the new work was carried to it on a straight line. The method of bracing described in the chapter on Dike XI A was used. On May 27, before any work had been done toward closing the outer break, excepting to drive the necessary anchor piles, you directed that all of the dike standing to the south of the north end of the outer break be removed. Under previous instructions the U. S. snag boat *C. R. Suter* had taken out 68 linear feet of this dike last fall, and from the 27th day of May to the 1st of June had removed 313 linear feet, when it became necessary for her to suspend work, as the dike was submerged. The accompanying map, Pl. I, shows the extent to which the dike is to be shortened in order that it may not fall within the proposed waterway, as lately revised by yourself.

Dike II.—The curtain of this dike was repaired in the latter part of August.

The cost of the above works is shown in detail in the Appendix, Exhibit C.

BANK-HEAD.

Chamois Bend (see Pl. I, range 249).—A new scheme for bank protection devised by yourself was given a trial in Chamois Bend. An experimental structure called a bank-head was built against the main right bank at the foot of the bend on range line 249, about 3,850 feet below the lower end of the Chamois Bend revetment. It was intended by means of the bank-head to firmly hold the bank at that point;

that the stretch of bank between it and the revetment would become stable after a certain amount of recession; that those conditions having been obtained there would be no necessity for revetting the bank as originally proposed. The estimated cost of the bank-head was $10,755.43. The estimated cost of the 5,000 feet of revetment which it is to take the place of was $35,000. Work on the bank-head was commenced March 13, and by the 26th of the same month it had been practically completed, although a small force was kept employed almost continuously thereafter until June 3 in keeping the structure free from drift during the flood; extending, repairing, and adding new curtains; extending upstream the pile work in upper-cone frustum, and the pile and rock work in the outer wall to a new connection with the bank, the latter having receded at the head of the structure as first built; restoring and dressing up to grade the supply of rock in outer wall above the middle ordinate, and in finishing some details of construction that had to be left incomplete when those parts of the structure were submerged. The necessity for the extension of the upper part of the structure was due to the fact that from economical reasons the length of development of the outer circle above the middle ordinate as originally constructed was made as small as was deemed safe, with the expectation of extending it to such extent as might be found necessary until the bank above became stable. The arrangement of the structure as built is shown in plan and cross section on the accompanying plate (XLI). In form it will be seen to consist of segments of the frusta of two cones having a common axis, the lower one resting against the bank and on the bottom of the river, its top cut by a plane at an elevation of 6 feet above standard low water, and developing an arc of a circle 724.2 feet in diameter and having a middle ordinate from the bank line of about 90 feet; the upper frustum, resting against the bank and on the lower one, developing an arc of a circle on the plane of contact therewith 640.4 feet in diameter and from a common center. The top of the upper frustum is defined by the height of the river bank. The conical surface of the lower frustum is defined by the rock of the outer wall; that of the upper by the pole screening. Both surfaces were of course subject to change—the former from movement of the rock due to scour, that might finally leave a fixed vertical wall of piles, the latter from accretions formed during stages of river in excess of 6 feet above standard low water.

In all 608 piles were driven, as follows: 446 in outer wall, 29 in anchor row, 9 in bank row, 109 in upper-cone frustum, and 15 for temporary outside anchorage. The piles in the outer row above the middle ordinate were driven to an average penetration of 22¼ feet, all others 20½ feet. It was intended that the piles in the outer wall be driven 22 inches between centers in the rows, and the rows 19 inches from center to center; but because of the packing of the ground, due to jar as well as displacement, it was found impossible to drive them to the desired depth so close together; the distance apart in the rows was therefore increased to 3 feet from center to center of pile, and brush was introduced between the piles vertically and as wattling, with a view of producing a practically tight wall. The specifications called for 3,400 cubic yards of one-man rock, of which 2,467 cubic yards were to be expended above the middle ordinate in a practically uniform section of 250 square feet and the balance below in diminishing section. In placing this rock an effort was made to first get on the bottom as quickly as possible after the outer row of piles had been driven a layer of rock of 2½ feet thick and of the required width—22.9 feet—above the middle ordinate and to diminish from there below; thereafter the requisite quantity of rock per linear foot was simply thrown against the piles in the outer circle and allowed to find its slope. Although all of the rock was put in place within seventy hours, there was some scour at the bottom, perhaps 2 to 4 feet, between the time of completion of the pile driving in outer circle and the getting on of sufficient rock to prevent scour within the limits of initial width of base. The space inside of the outer circle and the upper-cone frustum was to be filled by deposit from flood; for that purpose 1,497 linear feet, or about 31,600 square feet of curtains, were built, as shown in plate referred to. One of these, on a line 30 degrees upstream from the middle ordinate, is a tight curtain, made on 1-inch boards; the horizontal curtain extending from the outer wall to the base of the upper-cone frustum is made of wire netting, the meshes of which are partially filled with brush. The netting is supported on wales and ⅜-inch wire strand; all other curtains were made of poles in the usual way. The accompanying photographic views (Pls. XXV to XXX), show the structure in various stages of construction and after completion.

As above stated, it was expected that the bank-head would permanently hold the bank at that point, and that after a certain amount of recession the stretch of free bank above it would become stable. It was expected that a scour in front of the bank-head would occur, and, based upon some experiments made with a model, the quantity of stone put in the outer wall was thought to be sufficient to follow up a scour of 50 feet and so cover the resulting slope at that limit as to protect it against erosion. The form given the structure was thought to be such as would avoid at all stages the formation of violent eddies, so marked where the ordinary solid dike is used and which develop with such persistency, though less force, below the outer ends of exposed permeable dikes after they have been subjected to one or more floods. The extent to which these expectations have been thus far realized is indicated by the accompanying Pls. XXXVII to XL. A careful study of them and other charts thought to be too numerous for publication is full of interest and instruction, and while it shows that, after a somewhat prolonged but not very high flood, the effects upon local conditions of flow, the deposits formed, as well as the following down with scour of the stone on the subaqueous slope in front, were in close accord with expectations, there were some disappointing features, which were not at first noticeable, but developed later on, viz, the engorgement or narrowing and deepening of the active flow in the section in the immediate locality of the structure with the accompanying manifestations of head due to resistance to flow in abnormally high local velocities, the bending of the flow around the structure, the formation below the middle ordinate of a persistent and strong, though not destructive, eddy, and also a middle ground in the reach below. These phenomena were not what was expected and were at first thought to be entirely due to the structure; but a recent survey developed the cause to be a change of channel above, which resulted from the growth of accretion above Dike 28A′, nearly two miles up the river, by which the channel was thrown out of the head of the bend above the bank-head to the opposite side of the river and then returned immediately above the bank-head, in such manner as to make its effect upon the structure about the same as it would be upon the outer end of a dike 800 to 1,000 feet long, perpendicular to the direction of the approach of the deep water flow from the opposite bank above the bank-head, changing the direction of that flow about 50 degrees in 2,200 feet. Under these circumstances the attack on the structure was very severe, and it was subjected to nearly, if not quite, the full force of midstream flow, and naturally the head accumulated was much greater than would have obtained had the flow continued to be tangential. The head of water at the upper end of the structure was fully explained by the direction of attack, also the flow around the structure, and the eddy resulting from the great velocity. On June 7 there was a measured slope of .68 feet at the bank-head from the upper end of outer wall to a point 30 feet below the middle ordinate—the head of the eddy—and a negative slope of one-tenth of a foot from there to the lower end of the structure. Or referring to Pl. XL, the slope from A_3 to I was .59; from I to N, + 10 feet; .09 from N + 10 feet to Y, —.10 feet. Notwithstanding the severe and unexpected attack occasioned by the change of channel above, the structure showed its stability. If it had not been built it is probable that there would have been a great recession of the bank at that point and for some distance below. The effect of the bank-head on the channel below, in deflecting outward a large part of the flow, is quite evident from an examination of Pl. XXXVIII. The bank from the structure up to the end of the revetment, about 3,850 feet, has not receded to the line expected by a considerable distance, except immediately above the bank-head, where for 300 feet it has nearly reached that line. The upper part of that reach was protected by the change of channel; the lower part, subjected to a severe attack, was protected by the bank-head.

In the early part of the spring flood, just after the building of the bank-head and before the growth of accretion above Dike 28A′ had made such a marked change in the channel below it, the flow was more in the bend above the bank-head, as shown in Pl. XXXVII.

During the first period that the outer wall was submerged there was no eddy, and for a long distance below the structure and for some distance out from the shore the water was dead, the outer line of the dead water being a curve of large radius that was about tangent to the outer wall near the middle ordinate and came into the shore at a point about 1,800 feet below. In this area there was considerable deposit. There was also at this time much less velocity of current in front of the structure.

Thus far the object for which the structure was built has been accomplished, in that the 3,850 feet of bank above has not receded from erosion beyond a certain line, and the original bank below, for a distance of about 1,800 feet, has been protected.

When the channel is again placed in the bend above the bank-head, where it is designed to be, there is little doubt that the conditions of flow in the vicinity of the structure will be greatly improved. That is, there will be less velocity of flow along the bank-head, marked diminution, if not entire disappearance, of the eddy, and consequent tendency to deposit below the structure.

The cost of the bank-head in detail is shown in Appendix, Exhibit D.

EFFECTS OF IMPROVEMENT WORKS.

With some qualifications, the belief expressed in last year's report that there would be not less than six feet on any crossing on the division from Isbell to Gasconade was justified by the history of the past year. For about eight days in November when the river was at a stage of 1.7 feet below standard low water there was but 3½ feet in St. Aubert Bend, but soon after the effect of the Isbell group of dikes began to be manifest, and there has since been not less than 7½ feet from Isbell to Chamois; for a few days in the latter part of May, during an adjustment of flow incident to a rapid fall in the stage of the river, there was four feet on the lower reef of the Portland crossing below the bank-head. Since then there has been not less than eight feet. Such temporary engorgement will always attend a rapid fall from a high stage, and really should not be considered in a statement of the prevailing minimum depths available for purpose of navigation; the most serious exception occurred in the Straubs Bend reach. At times during last fall there was only four feet in Bluffton crossing and no more between Dike XXIII and the Gasconade River, but I still think that had the dikes been built which it was then supposed would be, the 6 feet or more would have been maintained throughout. There has recently been a marked improvement in the channel-way in the reach from Dike XXIII to the boat yard, and in fact as far as the Bluffton dikes, though there are indications that a new dike against the head of Miller Island and possibly the completion of Dike XXIV may be needed to hold the low-water flow over against the Bluffton dikes and down along the Heckmann Island revetment.

The improvement in the Isbell-St. Aubert reach effected by the Isbell group of dikes seems thorough and well established. The closing of Bear Island Chute is again urged as an important adjunct in the improvement of this reach.

PROCURING CONSTRUCTION MATERIAL.

The brush and rock used during the year were procured by hired labor; the piling, lumber, steel strand, bolts, and washers were largely supplied from stock left over from last year, although small quantities were purchased in the usual manner.

Brush.—The stock of barged brush, 1,449 cords, which had been left over from last year's work, was rehandled in August and only 355 cords of it found to be sound and fit for use. The parties were in service for 17 and 21 days, respectively, during the month of August, procuring 1,507.6 cords of brush for use on Heckmann Island revetment. September 30 a party large enough to furnish all the brush needed on both divisions of First Reach was organized and put in the field with a full equipment. They continued in service until November 7, when, having procured all the brush and poles requisite for the work, they were taken in and disbanded. Three thousand nine hundred and eighty and nine-tenths cords of brush and 257.6 of poles were barged, of which 2,786 and 157 cords, respectively, were delivered on the lower division, and 1,194.9 and 100.6 cords on the upper. Since then small parties were sent out from time to time for a few days only to cut poles or brush needed to work in with the old stock. The total quantity of brush and poles thus procured was 466 and 53 cords, respectively. The cost in detail of this material is shown in the Appendix, Exhibit E.

Rock.—During the year 15,507 cubic yards of rock ballast was expended. Of this amount 3,594 cubic yards was from stock left over from last year and stored on the river bank in Straubs and Chamois bends; the balance was procured from a quarry in the north bluff at the mouth of Little Tavern Creek. That quarry was opened on August 12 and actively operated until the end of September. From that time until the 23d of November, when work was suspended, a very small force was kept employed. On February 8 work in the quarry was resumed and continued until April 3, when the force was reduced to a small gang of laborers, who continued work for five days longer. A small force was engaged there from May 27 to June 3 and again from June 29 to the end of the year in barging rock. The total quantity of rock ballast procured at the quarry during the year was 12,717.4 cubic yards, of which 12,197.3 cubic yards was barged. The cost in detail of this material is shown in the Appendix, Exhibit F.

TOWBOAT SERVICE.

This service, including the transportation of construction materials and supplies, the handling of floating plant, and, in general, incidental dispatch work, was comparatively light, and on that account the large towboat *Alert* was not employed. For a short time during the low-water season—from October 21 to November 29—the light-draft steamer *Gasconade*, owned by the Hermann Ferry and Packet Company, was hired at the rate of $25 per day. The steam tenders *Arethusa* and *Sabrina* were in service from time to time as required, the former for a total number of two hundred and twenty-seven days, the latter for two hundred and twelve days.

PLANT.

Care and repair of plant.—No extensive plant repair was done during the year. The authorized repair to the storage ways in the Gasconade boat yard was commenced on the 2d of October and completed on the 10th of November. In all 1,920 new pile supports were driven to replace an equal number that had rotted so as to be unsafe. With the exception of a few sticks all of the old way logs, 10,818 linear feet, were put back. Between November 4 and December 8 the fleet, consisting of the following hulls, was pulled out and placed on the ways, all rakes shored, holes cleaned, and machinery properly drained and laid up for the winter: Twenty-four 100-foot barges, one of them carrying a boiler, steam hoist, a set of pile leads, and a Cram steam hammer; thirteen 64-foot barges, three of them with cabin quarters; four pile-driving apparatuses; four mattress boats; one grader; three large and two small construction quarter boats; the steam tenders *Arethusa* and *Sabrina;* the office boats *Margaret* and *De Russey;* forty-six skiffs, and a small barge, the latter belonging to the Gasconade River property.

The work of preparing floating plant for early service in the spring was commenced with a small force on the 5th of February. The following hulls were repaired, calked, and launched by the 22d of March, the first hull being launched on the 17th of February: Nineteen 100-foot and nine 64-foot barges; three steam pile-driving apparatus; steam tenders *Arethusa* and *Sabrina*; office boat *Margaret;* five small quarter boats; one mattress boat; ten skiffs and a small barge, belonging to the Gasconade River property. The character of the repairs was comparatively slight; rotten spots in the sides and head blocks of the barges and other hulls were cut out and engraven pieces put in, though occasionally scabs were used; the decks were patched, the rakes shimmed, and the fastenings, timberheads, and kevils renewed where needed; the roof of the *Arethusa* was entirely covered with new canvas and was painted with three coats all over; the roofs of other cabin pieces were patched and painted; the machinery on all of the pieces was thoroughly overhauled and put in good working order, the steam boilers and their steam gauges were inspected and tested; the boilers were subjected to a hydraulic pressure 50 per cent in excess of the working pressure allowed each one. Current repairs incident to the wear and tear of service were about as usual and were done from time to time as the need developed. The repairs to the yard plant and appliances were slight and comparatively inexpensive; the kitchen floor was repaired and a new chimney made and erected at the quarters; the roof of the steam saw and planing mill was repaired and the entire building given a coat of paint; the east and west yard pulling apparatus were several times overhauled; the boiler of the west apparatus was turned around 180 degrees, the fire front repaired, furnace walls and shed rebuilt, and boiler tubes expanded. A ventilator was made in the roof of the blacksmith shop; the coal tramway and car were overhauled, the wheels of the latter were turned down and banded, and the operating engine was removed from the south end of the track to a point off the track and about midway of its length. The entire stock of small tools and applances, such as pulling blocks, wheelbarrows, quarry tools, bilge pumps, etc., were gone over and, such of them as required it, repaired. The U. S. steamer *Alert* was overhauled and put in serviceable condition, and on the 19th of August turned over to her officers for temporary towage work on the Omaha division.

During a violent storm on the night of June 24, the following damage was done at the Gasconade boat yard by an onshore wind out of the northwest: Four pairs of steam pile hammer leads were blown down and badly wrecked; two of these were on shore and strongly guyed with three ⅝-inch strand; the other two were on the river, one of them on pile-driver pump boat No. 2, and the other on No. 6; the former boat was lying at the coal chute just outside the ice boat and when the leads went over they fell across that piece; the leads on No. 6 fell on the roof of the machine boat which was lying just inside. In both cases the leads were damaged more than the roofs of the boats on which they fell, although the lantern on the machine boat was crushed and the roof girders settled about 9 inches. The quarter boat *De Russey* (so called because the upper cabin was once a part of the cabin of the old snag boat of that name) was lying in the yard at the top of the bank and directly in the path of the storm. The afterpart of her upper cabin was demolished; the skylight roof forward and the entire starboard and forward guard rail and guard roof were carried away. To the southeast of the *De Russey* the three tower leads stood, each with six pairs of leads for sinking piles with a jet and although they were strongly guyed with ⅝-inch strand the wind twisted and overturned them with such violence that there was scarcely a whole timber left. Two of the ventilators on the steam saw and planing mill were blown off and five of the heavy rolled-plate glass in the skylights were broken. The steam tenders *Arethusa* and *Melusina,* which were lying at the bank, had their upper works more or less distorted and were kept afloat with the greatest difficulty. None of the employees were injured. The stoker of the *Arethusa* was blown overboard, but caught a line that was made fast to some piling and hung on till the storm was over.

Unserviceable property.—The unserviceable property on the Gasconade division and a portion of that on the Osage division was assembled at Gasconade and inspected January 11 by the Inspector-General, United States Army. The property then and previously condemned, which had been recommended to be sold, was disposed of, after advertisement, by public sale on March 27. In April seven of the condemned 100-foot barges were launched for the purchaser. Four pile-sinker pump boats were dismantled of their machinery and cabins and their hulls destroyed. The three tower pile leads were removed from their cross-boat hulls to the three old umbrella cross boats lying just south of them; the former hulls were then made use of to store the machinery and three of the cabins from the condemned pile drivers.

New plant.—The only new plant made during the year was nine wooden bilge pumps for use on barges and two office chests. The expenditures on account of plant during the year are shown in the Appendix, Exhibit G.

SURVEY WORK.

The operation under this heading during the year comprised the usual work of this kind, attending the building of dikes, revetment, and bank-head; the regular fall topographic and hydrographic survey of the reach from Isbell to Rhineland Landing; a series of special hydrographic surveys in the vicinity of the Little Tavern group of dikes; those opposite and the Bluffton group; two special hydrographic surveys of Chamois reach besides a number of others in the immediate approaches and front of the bank-head.

Isbell to Rhineland Landing.—The annual fall survey of the division was made this year by a party which started at a point 1 mile below Claysville on the Osage division and made a continuous survey to Rhineland Landing. They entered the lower division at Isbell on the 27th of October and completed the survey November 25. All shore line was run out, and cross sections of the river made on all the regular range lines. Unfortunately, a rise 3.85 feet occurred during the work. The accompanying map, Pl. I, and the cross sections of even date shown on Pls. II to XVIII were developed from the notes of this survey.

Special surveys and observations at dikes.—By your direction a series of special surveys and observations were made at the Little Tavern Dikes I, III, and V; Dikes II and IV opposite, and Dikes VII, IX, and XI, of the Bluffton group. The object in view was to secure accurate data showing in detail the configuration of accretions and bottom as well as direction and velocities of flow at and near permeable dikes. A party organized and equipped with special apparatus and a quarter boat was continuously engaged in this work from July 29 to October 3. Levels were run to show the dry contours for each foot in elevation of accretions on both banks in the Little Tavern reach, and on the left bank of the Bluffton reach. Several sets of located soundings on special parallel ranges 50 feet apart were made on both reaches—those in the upper reach extended across the stream; in the lower reach they were partial sections only. Two or more sets of very careful soundings were made about the head of each of the dikes, 5 feet apart for a distance of 200 to 250 feet on lines radiating from a point on the dikes at the shore line or near its outer end. The radial lines were uniformly 3 degrees apart and, within the stated radial limits, all of the waterway at each dike was sounded—thus at Dike II the space sounded covered the area included in an entire circle 400 feet in diameter. The soundings were made from a skiff, at tags spaced 5 feet apart on a steel cable. The latter was stretched taut from a pin at the center for radial lines to a skiff anchored in the stream; the skiff by means of a system of anchors and buoyed lines was firmly held in a fixed position which could be adjusted by means of reels to the exact radial line indicated by a transit set over the center. On both reaches several sets of current floats were run past the dikes and their paths and velocities observed. The notes were reduced and platted in the office, making 20 charts, from each of which a tracing was made and transmitted to you. The accompanying Pls. XXXI to XXXVI were selected for publication as constituting the best example for study of the influence of permeable dikes upon conditions of flow that has come under the writer's observation. The relation between dynamic head and velocity as algebraically expressed by the formula $h=\frac{v^2}{2g}$ is hardly more positive than the train of effects that follow a given head on a permeable dike in Missouri River, and are made manifest in the configuration of bottom and current lines. Within reasonable limits as to line approaching, flow, and kind of material forming bottom, the example is characteristic, and is an "open sesame" to many unexpected results attending improvements by permeable or solid dikes. For example, the reason for the formation of a middle ground in a reach of improved river the banks of which on either side are defined by dikes to a normal width, that, with a desired depth, would not permit bar formation, is made apparent; the observed fact that midflow is attracted rather than repelled is explained, and therefore the reason that failure so surely attends the persistent efforts that are made by private and corporate interests from one end of the valley to the other, to effect a crossing or marked deflection in the line of flow by means of solid dikes, or by an isolated dike of any kind.

On account of bank-head.—The revetted bank in Chamois Bend shows three quite marked bays, and it was for the purpose of studying the conditions of flow as affected by these bays that you directed a special hydrographic survey to be made, showing contours for each foot in depth as well as float paths and velocities through a reach including the middle and lower bay. The field work was accomplished between August 28 and September 12. It having been decided to build a bank-head on range 249 at the foot of the bend, a survey to determine 1-foot contours through the reach from range 251 to 247, inclusive, was made September 29 to October 3. The accompanying map (Pl. XXXVII) was compiled from that survey, the one last referred to and the annual low-water survey, and is intended to show conditions of flow prior to the growth of accretions above Dike 28 A′ and the construction of the bank-head. Pls. XXXVIII and XXXIX were developed from survey and observations made June 10 to 18. They show the conditions then prevailing after the spring flood had built up the accretions above Dike 28 A′ and some three months after the completion of the bank-head. Beginning March 8 and covering the time up to the date of the last survey a party was kept almost continuously employed in making surveys and collecting data for record and study of the changes that occurred in the vicinity of the bank-head. The reach covered by these observations finally extended from range 253 as far down as 245. Seven charts showing 1-foot contours and six showing float paths and velocities were developed from these surveys and tracings of them transmitted to you. Other charts showing partial profiles of bottom as developed from time to time at the bank-head on radial lines outside the outer wall were prepared and tracings submitted. These charts also showed the positions of the foot of the subaqueous slope of rock in the outer wall, as determined from time to time by means of a sounding lead, the end of which was cupped and filled with tallow. The accompanying chart (Pl. XL) presents about all of that data—the changes in bottom, at the structure, from a time prior to its construction to a time about three months after its completion. It also shows several positions assumed by the shore line as it receded.

The cost of these operations is shown in detail in the Appendix, Exhibit H.

MISCELLANEOUS.

Projects with estimates of cost of work necessary to complete the improvement of Gasconade division and for continuing the work by the expenditure of $150,000 during the fiscal year were prepared in accordance with your instructions, and submitted under date of July 13.

A report with estimates of cost of a new form of bank-head designed by yourself was prepared in accordance with instructions contained in your letter of June 15, and transmitted under date of June 28.

Special reports and examinations.—A joint report with estimates of cost of a new form of dike was prepared by Mr. Samuel H. Yonge and myself in accordance with your instructions, and submitted under date of July 10.

An examination, made by your direction December 22, of the river in the vicinity of Glasgow, Mo., for the purpose of determining whether a dike proposed to be built by local landowners could receive the sanction of the Commission, was reported on under date of December 30.

An examination was made on December 30 of a reported break at the head of the Quindaro revetment, which threatened the safety of the pumping station of the Kansas City (Mo.) water department and the usefulness of the revetment. The matter was made the subject of a special report, dated January 2.

Two other special examinations were made, as follows: January 14, of some pile-dike work placed by a private individual, adjoining the north bank of the river below Kansas City, Mo., about the possible effect of which complaints had been filed; and on the 25th of the same month, of the revetment on Nebraska City Island and the reach of the river in that vicinity, with a view of determining the necessity of immediate extension and protection of the work. The results of these examinations were submitted in reports dated January 22 and January 27, respectively.

Experiments with dike models.—In January and February a number of models of two-row dike work on a scale of one-eighth with bracing in various forms and details were made and subjected to breaking strains. The form that gave the best result of all that were tried was that above described as having been used on dikes XI A and XI B.

The cost of these experiments was $155.41.

REDUCTION IN COST OF WORKS FOR IMPROVEMENT OF MISSOURI RIVER.

As a result of the new forms of dikes which have been built this year a marked economy in the cost of such work has been effected that will become more apparent when the new work shall be constructed on a large enough scale to make fair comparison with previous practice. It now appears that even upon the comparatively small scale upon which the new work has been conducted that a saving of about 25 per cent has been effected.

The actual cost of the experimental structure built was $11,265. The experience gained in building the structure has shown where a considerable part of this cost could be saved in building future structures upon the same general plan. A new lan has been devised which it is believed will be equally or more effective at an imated cost for its construction of $6,000. At this cost, and supposing each bank-head to protect an average of 4,000 feet of bank, the cost as compared with the method of continuous revetment would be as $6,000 to $28,000, or a little more than one-fifth.

In closing I desire to acknowledge the support afforded me by my assistants and the unfailing interest and application to duty exhibited by all employees on the Gasconade division.

Very respectfully, your obedient servant,

S. WATERS FOX, *Division Engineer.*

Lieut. Col. AMOS STICKNEY,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

List of exhibits forming appendix to foregoing report.

EXHIBIT A.—Bill of cost of complete revetment on Heckmann Island No. 3.
B.—Consolidated bill of cost of dike construction.
C.—Consolidated bill of cost of dike repairs.
D.—Bill of cost of bank-head, Chamois Bend.
E.—Bill of expenditures on account of procuring willow brush.
F.—Bill of expenditures on account of procuring rock ballast.
G.—Expenditures on account of plant during fiscal year.
H.—Bill of cost of survey work.
I.—Statement of liabilities incurred during fiscal year.

EXHIBIT A.

Bill of costs of 2,675 linear feet of complete revetment on Heckmann Island during the fiscal year ending June 30, 1897.

Classification and extent.	Cost in item.
Procuring 203.8 cords of brush, during previous fiscal year, at a total cost of $2.3646 per cord, delivered on work	$481.91
Procuring 1,046.2 cords of brush, at $2.2941 per cord, delivered on work	2,400.09
Total cost, delivered on work, at $2.3056 per cord	2,882.00
Procuring 7,677.2 cubic yards of rock ballast:	
Chamois quarry, 104.4 cubic yards, delivered on barges, at $0.7322	76.44
Beckmann quarry, 2,859 cubic yards, delivered on barges, at $1.0131	2,896.42
Little Tavern quarry, 4,713.8 cubic yards, delivered on barges, at $0.9365	4,414.50
Towage	424.25
Total cost, delivered on work, at $1.0175 per cubic yard	7,811.61
Grading bank, 2,325 linear feet, containing 7,530 cubic yards of earth:	
Labor[a]	248.74
Subsistence	75.74
Supplies	63.50
Total cost, at $0.0515 per cubic yard	387.98
Anchorage of mattress (grading 201 trenches and digging dead-man holes):	
Labor	449.37
Subsistence	151.73
Supplies	26.15
	627.25
Construction of mattress, 2,725 linear feet or 250,674 square feet:	
Three-eighths inch strand, 34,667 pounds, at $3.3033	1,145.16
2,010 cable clips, at 6 cents each	120.60
Labor, weaving	1,108.30
Subsistence	410.53
Total cost, at $0.0111 per square foot	2,784.59
Ballasting mattress and bank, 7,677.2 cubic yards:	
Labor	1,443.87
Subsistence	542.67
Total cost of ballasting, at $0.2589 per cubic yard	1,986.54
Towage, moving construction parties, their plant and supplies	480.25
Grand total cost of 2,675 linear feet of revetment, at $6.34 per linear foot	16,960.22

[a] There is included in this an item of $37 97 for clearing and grubbing.

EXHIBIT B.

Consolidated bill of cost of dike construction, complete and incomplete, during fiscal year ending June 30, 1897.

Classification.	XXXII complete.		XXXIII complete.		XXXIV complete.	
	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.
182 cypress piling .... linear feet..	330	$44.14	3,318	$443.76	232	$31.04
486 pine piling .... do....	40	6.74	3,642	620.18	126	21.39
100,322 feet B. M. long-leaf yellow pine, feet, B. M	20.208	492.57	18,736	456.70	10,200	248.58
Fastenings, washers, spikes, etc ..... pounds..	2.647	46.49	3,580	76.38	1,894	31.35
Galvanized strand, ⅜ inch and ¾ inch .... do....	3,204	105.83	3,652	120.63	2,029	67.02
Brush and poles, delivered on works .. cords..	252	586.79	270	621.81	168	386.18
Rock from Beckmann quarry ... cubic yards..	400	405.22	....	....	....	....
Rock from Little Tavern quarry .... do....	....	....	520	486.99	239	223.85
Towage of rock to points of expenditure, miles	27	21.75	104	81.16	51	40.59
Coal .... bushels..	25	2.81	260	29.25	25	2.81
Oils, waste, etc	....	5.00	....	10.00	....	10.00
Labor:						
Pile driving	....	20.03	....	300.19	....	57.27
Mattress, weaving and sinking	....	405.58	....	376.52	....	284.11
Bracing	....	132.47	....	239.60	....	114.80
Curtaining	....	23.60	....	51.15	....	14.51
Subsistence	....	205.60	....	319.60	....	153.07
Steamboat service, towing all supplies, construction materials, except rock and brush, moving construction parties, etc .... miles..	75	60.43	73	59.82	32	25.22
Total cost	....	2,565.05	....	4,293.74	....	1,711.79

Classification.	XV complete.		XI A incomplete.		XI B incomplete.	
	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.
182 cypress piling .... linear feet..	1,908	$255.19	138	$18.46	1,356	$181.35
10 cypress piling (recovered material) .. do....	....	....	380	....	76	....
486 pine piling .... do....	7,030	1,197.14	3,048	519.07	5,570	948.57
25 pine piling (recovered material) ..... do....	....	....	372	....	516	....
10 cottonwood piling .... do....	300	19.50	....	....	....	....
1 white-oak piling .... do....	....	....	....	....	32	4.75
100,322 feet B. M. long-leaf yellow pine, feet, B. M	35,888	874.85	6,923	197.81	8,367	238.46
3,380 feet B. M. pine (recovered material), feet, B. M	....	....	2,395	....	985	....
Fastenings, washers, spikes, etc ..... pounds..	10,873	230.21	1,693.6	44.75	1,465	42.53
Galvanized strand, ⅜ inch and ¾ inch ... do....	4,859	160.90	2,693	92.26	7,029	283.40
Brush and poles, delivered on works .. cords..	433	993.34	88	112.93	205.9	257.67
Rock from Little Tavern quarry . cubic yds..	743	695.48	114.3	120.85	285	301.33
Towage of rock to points of expenditure, miles	40	35.80	15	13.71	47	37.82
Coal .... bushels..	455	51.19	88	9.79	162	18.02
Oils, waste, etc	....	14.00	....	4.16	....	7.27
Labor:						
Pile driving	....	556.86	....	108.93	....	175.76
Mattress, weaving and sinking	....	855.68	....	145.07	....	250.26
Bracing	....	388.76	....	206.09	....	188.40
Curtaining	....	125.57	....	29.24	....	7.59
Subsistence	....	521.34	....	146.40	....	192.67
Steamboat service, towing all supplies, construction materials, except rock and brush, moving construction parties, etc .... miles..	520	446.13	119	92.26	61	48.57
Total cost	....	7,421.94	....	1,861.28	....	3,184.42

EXHIBIT C.

Consolidated bill of cost of dike repairs made during fiscal year ending June 30, 1897.

Classification.	I A.		I B.		XX A.		II.	
	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.	Quantity.	Cost in item.
194 cypress piling..linear feet..	5,818	$778.11	....	....	2,052	$274.43	....	....
359 pine piling............do....	2,382	405.59	2,724	$463.83	8,908	1,507.03	....	....
15 cottonwood piling.....do....	....	....	....	....	450	29.25	....	....
10 white-oak piling......do....	....	....	....	....	290	81.90	....	....
Long-leaf yellow-pine lumber, feet B. M	25,768	628.12	10,208	248.77	29,256	718.26	....	....
Fastenings, bolts, washers, etc. pounds	7,012	164.74	2,719	66.23	9,810	231.72	31	$0.68
⅜-inch galvanized steel strand pounds	5,203	171.87	2,451	80.96	7,291	240.84	234	7.73
Brush and poles........cords..	277	635.47	97	223.09	555	943.94	10	23.65
Towage to points of expenditure........	....	....	....	....	18	14.50	....	....
Rock from Little Tavern Quarry.........cubic yards..	365	341.85	150	140.49	616	716.59	....	....
Towage to points of expenditure........miles..	77	58.23	48	42.04	192	163.05	....	....
Coal..................bushels..	395	44.44	100	11.25	400	44.50	....	....
Oil, waste, etc........	....	12.00	....	10.00	....	30.00	....	....
Labor:								
Pile driving	....	306.04	....	91.02	....	640.18	....	....
Mattress weaving and sinking........	....	361.69	....	155.88	....	1,073.19	....	....
Bracing........	....	409.11	....	168.44	....	596.08	....	....
Curtaining........	....	76.80	....	9.43	....	89.79	....	25.25
Subsistence........	....	456.41	....	164.80	....	764.39	....	9.07
Towage, plant, material, and supplies..............miles..	838	300.97	282	240.81	454	422.41	....	....
Total cost........	....	5,151.44	....	2,116.54	....	8,527.00	....	66.38

EXHIBIT D.

Bill of cost of bank-head in vicinity of Chamois, Mo., 1897.

Classification and extent.	Cost in item.	Total.
Pile driving:		
Labor........	$798.22	
Piles—		
Pine, 9,444 linear feet........	1,463.82	
White oak, 2,308 linear feet........	286.19	
Water oak, 7,215 linear feet........	649.25	
Cypress, 4,239 linear feet........	520.12	
Coal and supplies........	82.89	$3,800.69
Waling, bracing, and curtaining:		
Labor........	663.85	
Lumber, 12,667 feet B. M........	231.87	
Brush and poles, 56 cords, at $1.70 per cord........	95.20	
Strand, ⅜-inch galvanized........	40.65	
Other fastenings, screw bolts, driftbolts, plate washers, spikes, staples, and clips........	300.22	1,331.79
Rocking:		
Labor........	332.28	
Rock, delivered on barges, quarry landing, 3,971 cubic yards, at $1.0573 per cubic yard........	4,198.54	4,530.82
Subsistence........	....	583.20
Towboat service........	....	1,018.63
Total cost........	....	11,265.13

EXHIBIT E.

Bill of expenditures on account of procuring willow brush during fiscal year ending June 30, 1897.

Classification.	Quantity.	Average cost per cord.	Cost each item.
Brush privilege..........cords..	4,878.3	$0.0922	$449.50
Binding wire..........pounds..	3,331	.0229	76.28
Labor and subsistence:			
Cutting and binding..........cords..	4,878.3	.6584	3,211.92
Hauling..........do....	4,878.3	.5551	2,707.87
Barging..........do....	4,878.3	.3795	1,851.47
Total cost on barges..........	....	1.7008	8,297.04

EXHIBIT F.

Bill of expenditures on account of procuring rock ballast at Little Tavern Quarry during fiscal year ending June 30, 1897.

Classification.	Quantity.	Average cost per cubic yard.	Cost each item.
Quarry privilege..........cubic yards..	12,197	$0.01	$121.97
Quarry supplies, explosives, fuse, powder, etc..........	....	.0693	880.79
Labor and subsistence:			
Stripping and quarrying..........cubic yards..	12,717.4	.6486	8,249.42
Hauling to barge landing..........do....	12,197.3	.2444	2,981.42
Barging..........do....	12,197.3	.0850	1,036.45
Total..........	12,717.4	....	13,270.05
Average cost per cubic yard loaded on barges..........	....	1.0573	....

EXHIBIT G.

Expenditures on account of plant during fiscal year ending June 30, 1897.

Classification.	Labor.	Subsistence.	Supplies.	Materials.	Cost in item.
Care of plant:					
Watching..........	$9,088.18	$2,822.80	$936.15	....	$12,847.13
Pulling out (54 hulls)..........	1,459.58	417.73	142.06	....	2,019.37
Launching (39 hulls)..........	817.64	268.89	42.83	....	1,129.36
Cleaning, sorting, and storing..........	39.59	16.46	18.25	....	74.30
Steamboat service..........	....	....	....	....	1,386.33
Total..........	11,404.99	3,525.88	1,139.29	....	17,456.49
Repairs and alterations:					
Yard plant..........	2,920.48	804.57	60.69	$2,291.63	6,077.37
Floating plant..........	3,486.12	673.46	644.92	378.02	5,182.52
Current miscellaneous..........	1,045.84	212.60	80.74	126.77	1,465.95
Total..........	7,452.44	1,690.63	786.35	2,796.42	12,725.84
New plant constructed:					
Office chests (2)..........	39.63	7.60	....	6.14	53.37
Bilge pumps (9)..........	15.63	3.06	....	12.20	30.89
Total..........	55.26	10.66	....	18.34	84.26
New plant purchased:					
Lamps, lanterns, burners, brooms, brushes, and other subsistence utensils..........	....	....	....	....	61.12
Gauge cocks, oars, picks, shovels, wrenches, files, saws, augers, and other like small tools..........	....	....	....	....	231.57
Hose, steam and water..........	....	....	....	....	408.20
Rope, manila..........	....	....	....	....	397.31
Total..........	....	....	....	....	1,098.20
Grand total..........	....	....	....	....	31,364.79

Exhibit H.

Bill of cost of survey work done during the fiscal year ending June 30, 1897.

Classification.	Cost in item.
Supplies and materials	$32.42
Labor	5,011.28
Subsistence	1,131.53
Towage	557.42
Total cost	6,732.65

Exhibit I.

Statement of liabilities incurred under suballotment for systematic improvement in First Reach on account of improvement in Gasconade division, for each month of the fiscal year ending June 30, 1897.

Month.	Labor.		Construction material.	Plant material.	Plant purchased.	Subsistence stores.	Supplies.	Sundries.	Total each month.
	Administration.	All other items.							
July	$1,711.31	$2,606.28	....	$313.44	$29.00	$1,119.36	$137.07	$35.79	$5,952.25
August	1,292.00	10,305.45	$1,133.08	173.52	111.92	2,271.90	615.05	19.44	15,922.36
September	1,256.44	7,881.81	126.06	31.98	3.88	1,900.86	618.06	73.74	11,892.33
October	1,069.01	12,314.16	3,983.06	45.05	12.60	2,859.09	841.52	a 824.01	21,448.50
November	769.26	10,335.75	409.28	65.81	118.16	1,156.96	766.65	a 698.70	14,320.57
December	590.67	1,907.15	....	122.47	31.69	781.36	99.54	36.85	3,569.73
January	545.08	916.77	....	135.01	....	28.09	725.80	11.40	2,362.15
February	646.77	4,510.70	407.00	686.35	304.40	431.73	517.90	45.57	7,550.42
March	1,275.00	9,206.48	440.89	255.22	106.76	1,690.13	689.88	125.49	13,789.85
April	1,192.50	3,556.01	5.09	71.27	302.15	1,231.78	64.71	51.38	6,474.89
May	1,313.35	3,843.30	9.40	....	....	886.82	295.46	6.72	5,855.05
June	1,244.34	4,724.07	56.34	172.31	23.50	667.32	546.47	60.69	7,495.04
Total	12,965.73	71,607.93	6,570.20	2,072.43	1,044.06	14,524.90	5,918.11	1,489.78	116,133.14

a These items include $912.50 for hire of steamer *Gasconade.*

Grand total of liabilities incurred during fiscal year on account of suballotment for systematic improvement, First Reach	$116,133.14
Add value of construction materials and supplies on hand at close of previous fiscal year	20,160.48
	136,293.62
Deduct value of construction materials and supplies on hand June 30, 1897	4,875.13
Total net expenditure during fiscal year on account of improvement on Gasconade division	131,418.49

APPENDIX K.

ANNUAL REPORT ON CONSTRUCTION OF LOCK NO. 1, OSAGE RIVER, MISSOURI, BY CAPT. H. M. CHITTENDEN, CORPS OF ENGINEERS.

Missouri River Commission,
Office of the Secretary,
St. Louis, Mo., June 30, 1897.

Colonel: I have the honor to submit the following report of operations upon the construction of Lock No. 1, Osage River, Missouri:

At the close of the last fiscal year the work had been taken from the hands of the contractors by purchase of plant and material and authority had been obtained to carry out its further prosecution by hired labor. The plans and specifications for the work were also subsequently changed by a reduction in the size of the lock to 220 feet between quoins and 42 feet width, by the substitution of concrete for rock masonry in its construction, and by establishing the lower miter sill at reference 94 above the St. Louis directrix. This partial revised project was approved by the Chief of Engineers November 23, 1896. A completion of the revised project, both for lock and dam, was deferred to a later day.

Active operations were resumed about the middle of July, the immediate object in view being the excavation within the cofferdam for the foundation of the lock. This work, which continued for upward of four months, was attended with great difficulty. The river bottom is composed of alternate layers of impervious clay and water-bearing sand or gravel. The water in the gravel layers is under considerable pressure, and wherever pierced with pipes would force itself up to a level some feet above that of the river surface. As there had been several pile holes sunk into these successive layers, and as the pit for the pumps was sunk below the bottom of the proposed excavation, there were numerous springs spread over the bottom, all of which let in considerable quantities of water. Add to this that wherever a layer was cut through as the excavation proceeded it became a continuous fountain entirely around the coffer, but particularly on the shore side, and the problem of keeping the water down without a very extensive pumping plant was not easy of solution. Two new pumps, 12 and 15 inch, centrifugal action, were added to the plant already on hand, and with these it was barely possible to hold the water down to the bottom of the excavation. The earth was removed by hand except over the area which was within reach of a clamshell dredge maneuvered by means of a derrick on the cofferdam. The excavation was practically completed at the end of November, and preparations for driving piles in the foundation were begun. This work was completed before the end of the following month, and the work of preparing the piles for the grillage was in progress when the heavy flood, which arrived early in January, suspended work on the 6th of that month. An almost continuous stage of water, too high to permit pumping out the cofferdam, has prevented a resumption of operations since.

During the progress of the work as above described the purchase and delivery of materials for the lock has gone on. The sand for the concrete is Missouri River sand dredged from Osage Chute, at the junction of the two rivers. The gravel has been dredged from the bars of the Osage River near the lock, and both materials are piled on the bank opposite the site of the lock. The delivery of the gravel was completed May 15, 1897, and that of the sand June 23.

The lumber and iron for the grillage foundation was delivered in December, 1896. The cement for the foundation was in part delivered in November, 1896, and the balance in June, 1897. Contracts have been entered into for the lumber for the concrete forms and for the cement to be used in the construction of the walls.

The more important materials thus delivered or contracted for are as follows:

Gravel	cubic yards	12,000
Sand	do	5,105
Cement, natural	barrels	3,000
Cement, Portland	do	5,000
Lumber, grillage, oak	feet B. M.	90,000
Lumber, grillage, pine	do	93,533
Lumber for forms, pine	do	132,753
Quoin posts, iron		4
Valve frames, iron		6
Concrete mixing plant		1

and a considerable quantity of minor articles.

Negotiations are in progress for the purchase of an additional tract of land for the erection of buildings at the lock.

During the past winter the full revised project for lock and dam was prepared with plans and specifications for construction. This project was approved June 29, 1896.

In connection with the determination of suitable dimensions for inlet and outlet openings, considerable information was collected in regard to existing locks in this country, their size, dimensions and forms of valve openings, and times required for filling and emptying. The data so collected were analyzed by Mr. James A. Seddon, assistant engineer on surveys, gauges, and physical data, and the results arrived at seem to be of sufficient importance to justify publication. In a general way they show—

(1) That for the same valve area the filling or emptying of a lock is more rapid through the gates than through culverts in the walls. The effect of trends and sharp angles is distinctly noticeable.

(2) That with like conditions of valve connection the rate of filling seems to be slower than that of emptying, even after the effect upon emptying of contraction of area by uncovering the upper miter sill is eliminated.

Mr. Seddon's report, with accompanying plates, is submitted herewith.

In determining the kind of cement to be used in the concrete of the lock walls considerable study was given to the question of a combined use of Portland and natural cements. It was thought that if a core of natural cement concrete could be used, faced with a thick exterior of Portland concrete, the weight necessary for stability, and the hardness and strength necessary to resist frost, abrasion of ice and boats, and wear of current, could be obtained at a much reduced cost below that of all Portland concrete. To determine whether a joint formed by the junction of the two kinds of cements or concretes would exhibit any special weakness arising from different rates of setting, a considerable number of briquets half and half of natural and Portland cements and several blocks of concrete 6 by 6 inches by 2½ feet similarly composed were made. The results, which are stated in detail in the accompanying report of Assistant Engineer F. B. Maltby, show conclusively that there is no special weakness in such a joint, but that the joint is in every case stronger than a similar section of the weaker cement. Photographs illustrating the briquet experiments accompany Mr. Maltby's report.

The revised estimate for the entire cost of the lock and dam, as presented in detail in the new project, is $325,000. This estimate being apparently a considerable increase over previous ones, it is important, for a proper understanding of the matter, to present a review of these earlier estimates.

The first of these estimates appears in Major Miller's project, dated May 14, 1891.

Lock.—Length over all, 339 feet 6 inches; length between quoins, 275 feet; width, 50 feet; lift, 8 feet 6 inches.

Dam.—A timber and rock structure of 11.5 feet lift.

Cost of lock and dam, $187,244.

This project was modified somewhat on the recommendation of General Comstock and the above estimate was increased to $200,000. (Annual Report Chief of Engineers, 1892, p. 1742.)

The first important revision of this estimate occurred in 1894, when the whole subject of the Osage Lock and Dam was exhaustively reviewed by a committee of the Missouri River Commission, consisting of Major Allen, Corps of Engineers, and Mr. R. S. Berlin, in a report to the Commission dated September 22, 1894. (Published in minutes of Commission meeting of November 28, 1894.) The lock considered was to be of the following description:

	Ft.	In.
Length over all	340	6
Length between quoins	276	0
Width of chamber	52	0
Lift	10	6

A needle dam was also provided for. The following extract from the committee's report will show their estimate of the cost of this work:

"Estimated cost of the lock, including lockkeeper's dwelling, etc., according to best information at present attainable, $216,000.

"The cost of the dam has not yet been figured, but it seems safe to assume that it will be sufficient to bring the total cost of lock and dam and appurtenances to about $300,000, though these figures may be modified one way or the other after proposals are received for building the lock."

This estimate does not seem to have been adopted by the Commission, because in the next annual report the probable cost of the lock and dam is thus stated:

"Based on such data as we now have, it appears that the probable total cost of the lock and accessories will be about $190,000, and of the dam about $75,000, or a total of $265,000, as against the estimate of $200,000 submitted in 1892. For reasons above given, this latter estimate could only be regarded as approximate."

The "reasons" here referred to relate to a preceding paragraph in the same report, viz:

"In November, 1894, a plane-table survey was made from the site selected for the lock and dam to a point about 30 miles above to ascertain the additional amount of land that would be overflowed, due to a stationary dam of 10.5 feet lift, should the river reach the highest recorded flood stage. The results of this survey showed that such a dam would, at the above stage, cause an additional overflow of 636 acres within the limits of the survey, or an increase of about 20 per cent in area of land flooded. In view of these results, the Commission decided February 11 that a modification of the plans of the dam to provide for a stationary dam of less lift than 10.5 feet, and upon this a low, movable dam to bring the lift to 10.5 feet when raised, would be advisable. It is proposed during the current season to make a complete examination of the site of the dam, and to prepare new plans and estimates of cost in accordance with the above decision."

The dam provided for in the above $75,000 estimate was for a movable crest of only 2¼ feet lift, estimated to cost only about $11,000, and was in no sense a comprehensive project, such as was contemplated in the report of the committee above referred to.

In January, 1895, an additional estimate was prepared for a movable dam, the type considered being the Chanoine Wicket. This estimate was $182,500. Substituting this figure for $75,000 would give as the estimated cost of the lock and a movable dam $372,500. It will thus be seen that no estimate for a lock and a movable dam of any comprehensive pattern has ever been below $300,000. None of these estimates, however, were ever acted upon.

Subsequent to the date of the Annual Report for 1895 it developed that the foundation of the lock would have to be lowered about 5 feet for reasons fully explained in the present revised project and accompanying papers. As nearly as can be determined from the correspondence on the subject, an estimate of the additional cost, which this change of plan would involve, was about $45,000. With this additional cost, the foregoing estimates of $300,000 and $372,500 would become $345,000 and $417,500, respectively.

The changes authorized in the partial project approved by the Chief of Engineers November 23, 1896 (file mark $\frac{10688}{8}$), viz, a diminution of the size of the lock, and the substitution of concrete for rock masonry in its construction, as well as the proposed adoption of a less expensive type of dam, will materially reduce the above estimated cost. The work has now progressed far enough to make possible a very close estimate for the entire work. This is given below:

Cost of lock.	
Expended to March 31, 1897	$117,495.10
Uncompleted work.	
Cost of masonry and foundation (see detailed estimate attached)	55,986.08
Cost of fixtures, appurtenances, and miscellaneous expenditures pertaining to lock	19,224.70
Dam.	
Cost of entire structure	119,763.69
Total	312,469.57

As a safe amount, covering all contingencies, the sum of $325,000 is considered amply sufficient for the construction of the lock and dam and accessories, and this sum is submitted as the final estimate of the total cost of the work. There is now available the sum of about $62,000, and as the estimated cost of completing the masonry of the lock is about $56,000, it is hoped to accomplish this part of the work during the coming season.

As the construction of the dam will be the work next in order after the operations of the present season are closed, it is very important that a recommendation should be made to Congress either that the entire sum necessary for its construction be appropriated at once or that the Commission be allowed to contract for its completion. The natural conditions in this part of the river make it particularly important that this structure be built in a single season. From January 1 to July 1 it would be submerged the greater part of the time with successive floods passing over it. The structure in a partially completed state would inevitably suffer much damage and its cost be thereby greatly increased.

Very respectfully, your obedient servant,

HIRAM, M. CHITTENDEN,
Corps of Engineers, U. S. A.

Lieut. Col. AMOS STICKNEY,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

APPENDIX L.

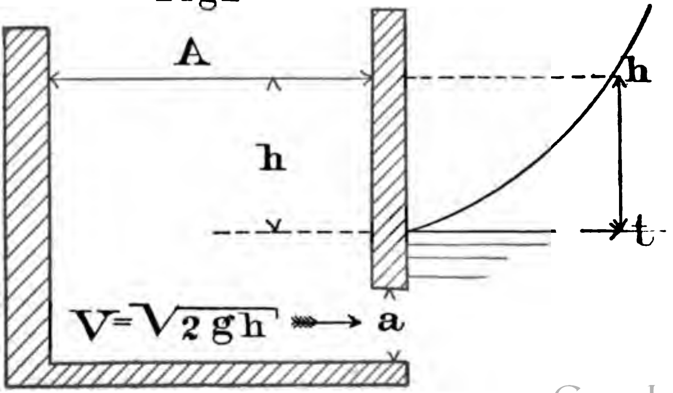
REPORT ON FILLING AND EMPTYING LOCKS, BY JAMES A. SEDDON, ASSISTANT ENGINEER.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., February 20, 1897.

CAPTAIN: I have the honor to present the following report on the data of filling and emptying locks, submitted to me for study:

The following is the general equation of emptying:

Fig.1



Taking it as in Fig. 1 at any point of time t, with its corresponding head on emptying valves h, surface area of the lock A and area of emptying valves a, we have the following relations:

The outflow is at the rate of $m\,a\,\sqrt{2\,g\,h}$, where m corresponds to a coefficient of efflux through whatever forms or combination of forms the emptying may be effected. While any volume withdrawn from the lock is represented by $A\,.\,\triangle h$. In a differential interval of time, therefore,

$$m.\,a.\,\sqrt{2\,g\,h}.\ dt. = \text{outflow} = A\ dh.$$

$$\text{or } dt = \frac{A}{m.\,a.\,\sqrt{2\,g}}\ .\ h^{-\frac{1}{2}}\,dh;\ \text{or } t = \frac{2A}{m.\,a.\,\sqrt{2\,g}}\ .\ h^{\frac{1}{2}} + c$$

but C = O as t and h become zero together, and the equation of emptying becomes

$$t = \left\{2\sqrt{\frac{h}{2\,g}}\right\}\ .\ \left\{\frac{A}{a}\right\}\ .\ \left\{\frac{1}{m}\right\} \qquad \text{I}$$

and the same equation holds for filling the lock, by taking in that case time and head measured from the level of the lock full.

In this equation I the first factor $\left\{2\sqrt{\frac{h}{2g}}\right\}$ has for the only variable in it the head h, and it expresses a purely mathematical relation between force and velocity. It may be computed once for all through a range that will cover the lift of all locks, and its value in all at a given point of h is the same.

The second factor $\left\{\frac{A}{a}\right\}$ expresses all that variation between the volume to be drained at any level in any lock and the area of the valves that are designed to drain it. It is an expression wholly of the geometry of the design. And as this enters the equation of time in the ratio of these areas, its value is not affected by the absolute magnitude of these quantities. So far as this factor is concerned, a lock may be large or small as long as there is a square foot of valve area to a *given number* of square feet of lock surface to be drained, the time of draining given heads will be the same.

The third factor $\left\{\frac{1}{m}\right\}$ involves all that is known or unknown of resistance to flow in the different forms and different types of form, that have been designed, summed as it all is in m, generally termed the coefficient of efflux or discharge; and as this is the one unknown element, the study is aimed to bring the values of m in the different data into comparison.

This is most readily done by bringing the observed times to a time standard, which corresponds to a fixed value of the second factor $\left\{\frac{A}{a}\right\}$. This is arbitrarily assumed for the standard as 200, approximately a mean of general practice; and it is plain that in any actual lock where there was less than 200 square feet of surface to each square foot of valve area, the observed time of draining between any levels would be correspondingly shorter than the standard; while if its actual value of $\left\{\frac{A}{a}\right\}$ was greater than 200, its observed intervals of time would be correspondingly longer than the standard. We have, therefore, calling t the standard time, and t_{obs} the observed time.

$$t_{obs}\ :\ t = \frac{A}{a}\ :\ 200 \text{ or } t = \frac{200 \circ a}{A} \circ t_{obs} \qquad \text{II.}$$

By this equation all the observed intervals of time were reduced to this standard and in what follows only this standard time will be generally referred to.

It may be worth mentioning that not only is this reduction to standard time necessary to compare observations on different locks, but often in the same lock and notably between filling and emptying; where there is a batter in the walls or the upper miter sill becomes exposed, the value of A changes, and while in filling, these smaller areas at the bottom are filled with the fastest inflow and the greater ones at the top with the slowest; the reverse is the case in emptying and with identical valves, the observed time of emptying from this cause may be distinctly shorter than that of filling, while the curves of observed time have this arbitrary variation in them.

The observed intervals reduced to standard times and summed from the levels of the lock full or empty, respectively, give from point to point the corresponding values of time and head by observations, while from equation I, which in standard time has now become $t=2\sqrt{\frac{h}{2g}}\circ\frac{200}{m}$, values may be calculated for various assumed values of m, and have been so calculated and are given in tabulation, and shown platted as curves on Pl. I, while the curves given by the observations are shown an Pls. II to VIII.

In some cases it is stated that the observations were not carried through to the exact point at which the lock was full or empty, while in other cases it was evident that the same course had been followed; this then would only give the curve from some point above its origin up to the range of the lift in the lock at that time, and to complete it for comparison and study it must be sketched into its approximate origin. This is done with sufficient accuracy by adjusting the incomplete curve, platted on transparent cross-section paper, over the group of calculated curves of Pl. I, drawn from a common origin and covering the general variations in the value of m; where the run of the incomplete curve as a whole may be approximately traced down to its zero.

By the same process of study in other cases the interval of time in the last stage of filling or emptying has been corrected. Here, as from ten to thirty seconds will be required for the last half-tenth of rise or fall, it is easy to make considerable errors in time, which in the form of the study effect the value of time at all points of the curve. It is true, however, with both of these forms of correction, that the original observation may be right in fact, and the appearance of error given it by the change of head in the upper or lower pool, which would depend entirely upon the local conditions of the waterway. But even where this may be the case, the necessity of comparison requires us to bring the curve to its zero at the zero of the average head under the action of which it has been formed.

These corrections are simply a ± to the time or head of the last interval of filling or emptying, and are given with the platted data in such cases, so that if it is thought desirable to repeat observations it may be readily determined whether the original was a real error or simply due to a local variation in head. They only effect the interval between the origin and the first point of the curve as plated—from which all other points follow, deduced from the intervals of time and head as observed.

Pl. II shows the emptying of ten locks of the Fox River canals. They are arbitrarily numbered, and all points in the emptying curve of each lock are indicated by the corresponding number, with a fair curve sketched through them. The wholly arbitrary part at the top during the time that the valves were being opened are shown branching off from these curves, and for a further comparison the fair curves are in all cases carried up to at least a 10-foot head.

These locks are all emptied through balanced valves in the lower gates, with no great difference in the size of the valves, as seen from their number and total area. We might therefore expect to find in all about the same curve of emptying, and we do find this to be the case in Nos. 1, 3, 4, 6, 7, 10, but Nos. 9 and 5 show much larger values of time (smaller coefficient of efflux), while 8 is distinctly smaller time than the average, and 2 is so small that it would seem that here some mistake must have been made in the valve area.

With attention called to these variations, the engineer in charge can probably readily find their explanation in his special knowledge of the lock. They may be features of construction, the valves may not have been fully opened, or there may be local characteristics of the waterway to account for them, while the explanation in connection with this determination of the magnitude of its effect would be most interesting to the engineer engaged in such work.

Pl. III shows the filling of the same set of locks. Here but five of them are filled through valves in the gates, and this group as a whole shows a larger value of time than the average of emptying. It covers, as may be noted in a comparison, approximately the range between the average and the extreme of the emptying curves. If no other explanation may be formed, it will probably indicate a relative check to inflow due to the confined area of the lock. The second group, where the locks are filled through chambers or culverts, show the marked increase in time due to this difference in design.

Pl. IV shows the emptying and filling curves of the Muskingum River locks as numbered. There seems to have been some difficulty here in carrying the observations to their true levels, and in most cases the final interval required a correction. The emptying is certainly rapid for the combination of valves and culverts, and, in contrast with the slow filling, is very striking. The valves are large in both cases, but the culverts are curved in emptying and have sharp corners in filling, but it hardly seems that this would account for the difference. The screens at the filling portals must have been a serious resistance, and indeed between the first and second filling of Lock No. 6 (numbered on curves 6_1 and 6_2) the wide divergence can only be accounted for by the difference between a clean and a foul screen.

Pl. V shows the curves of another series of locks. Perhaps here some closer adjustment to the correct origin might have been made; in fact, the divergence shown in filling can hardly be explained except in this way. But as the Erie locks were only measured between even feet, leaving an undetermined interval of both time and head to the origin, no very close adjustment was attempted, and the other data was evidently close enough to fairly correspond with this in precision. True, No. 5 emptying is wide of the rest, but there through all the period covered by the four upper points the valves were being opened, so that there is not much of a true curve left to judge from.

On Pl. VI the locks of the Kentucky River, Nos. 1 and 2, show the difference between valves in gates and culverts, in which the greater efficiency of the valves in gates is most marked, while No. 3 of the Louisville locks, also operated with valves in gates, but confirms the above conclusion. The filling and emptying curves of each lock are also shown here in contrast. However, in the case of filling No. 1, as the valves are only fully submerged through the last three feet, the filling is of course more rapid, and its curve is not comparable with the others. It approaches, as we see, what would be its theoretic form if the valves were discharged into air—a straight line of a given inclination determined by their coefficient of efflux and the constant head of the upper pool upon them. It serves, however, even in this case, to show that the coefficient is distinctly smaller in filling than in emptying, as is also markedly shown by the divergence of the curves in the other cases.

As the data furnished for the above locks gives no difference in the design for filling and emptying we would be led to conclude that there was a large element of resistance to flow which was a characteristic of filling alone, did not the data presented on Pl. VII lead us to an opposite conclusion. Here in the Des Moines locks we might have anticipated a slower filling through the long culverts in the side walls, but find it for both locks the same and between the two emptying curves, which with shorter culverts and the same design show quite a divergence. While again in the Galena lock, though the filling valves are only submerged through about half the range, there is enough to show a close correspondence between filling and emptying.

We must not conclude from the above that there may not be a greater resistance to filling than to emptying, for indeed we would expect the flow into the lower pool to be freer than into the confined and agitated volume of the lock, while taking the data altogether there is a decided preponderance in favor of this conclusion. The contrast here between Pls. VI and VII has been mainly noted to show that it is not safe to take the suggestions from a few cases as a measure of this.

It is thought that the much more decided effects of the different designs should be determined first, and these can not be said to be yet determined, for while they are the most apparent on the data, we have not enough general information on the subject of the designs to explain the differences that perhaps may be easily explained, while possibly some of the differences can only be explained by imperfectly set valves or unknown obstructions. With the data freed from these uncertainties in the determination of about the correct coefficient for given types operated in a waterway whose levels are not effected by filling and emptying, the general difference between filling and emptying would show itself in its true values.

To illustrate the effect of change in level of the pools, the data of the "Soo Lock" was selected, and is presented on Pl. VIII. This data was very carefully taken, the levels in the lock being determined by the rise or fall of a large steam barge, the changes being read with the level from the rod, held about at the center of buoyancy of the barge, while the time element was measured upon an observatory chronograph. At the same time in the case of filling there was quite a large oscillation in the level of the upper pool, which is shown in the plate with the filling curve, on its corresponding time scale, as nearly as it could be reproduced from the diagram of the data.

The two levels are of course identical at the origin of the filling curve, the point where the lock is full, and the standard times are platted to their actual stages *in the lock* below this point, but here this does not correspond with the head on the filling valves, for the level of the upper pool at the same time is below or above this point, by the value in its variation of the ordinate $\triangle h$, which is platted to the same zero and the same scale as h. The actual head at any point with which the lock is filling is therefore $(h—\triangle h)$, and this is the head to which the observed intervals of time correspond, while in a representative curve they should have corresponded with h.

As, however, $\frac{dt}{dh}$ or the time rate at any point, varies as $\frac{1}{\sqrt{h}}$, the standard intervals

Δt_s may be further corrected to the intervals of this representative curve Δt by the proportion

$$\Delta t_s : \Delta t = \frac{1}{\sqrt{h - \Delta h}} : \frac{1}{\sqrt{h}} \text{ or } \Delta t = \sqrt{\frac{h - \Delta h}{h}} \cdot \Delta t_s$$

which, strictly speaking, is a differential equation to be integrated between the limits, but which in the observed variation of Δh to time may be approximated altogether as closely as the data justifies by taking the mean of its value at each end of the foot intervals as a mean for the whole interval, and correcting the standard intervals of time by this simple proportion. This has been done, and through the points so corrected the filling curve is drawn, which is the deduced curve for a full value of head on filling valves.

Points ⊡ show the corrected and ◬ the uncorrected values of time in this case, and between them the distortion due to this change of head may be noted. It is seen that a very small excess of head, due to momentum in the approach, through the last stages of filling serves to counterbalance quite a large deficiency in the earlier stages, and materially changes the shape of the curve near the origin. It is in the direction of a divergence from the form of computed curve with a constant coefficient that has been noted all through the data, and which is also thought to include an increase of coefficient with the small velocities in the last stages of filling or emptying. The two combine in the same direction to give a special character to this part of the curve; one element the local phenomena and the other a general law of coefficients, but which can not be satisfactorily separated without fuller data on this part of the curve and the changes of head.

Aside from the above, the data as a whole may be said to show a fairly constant coefficient of efflux through the greater part of the range. The curves define a very regular law in each case, and the extreme divergence of the points in general amount to but a tenth or so in level or a few seconds in time, which might be expected as accidental errors of the individual observations; and while there is almost uniformly the noted divergence near the origin, and in some cases continued through the range, still there is altogether enough parallelism between the actual and the calculated curves, when taken in the light of possible distortions from changing head, to lead us to accept a constant coefficient as the general character of this flow, though of course it is understood that this constant is but an empiric expression for a slight variation, which only generally begins to have an appreciable value as we approach the origin.

As an aid to the study of this general coefficient Pl. IX was prepared, where the calculated curves of Pl. I, in the place of being brought to a common zero at the origin, are brought to the common zero at the stage of 10 feet, up to which value of h all the curves of the data were sketched. By superimposing the data upon such a group we have an accurate means of estimating the actual coefficient in this part of the filling and emptying where it has its least variation, and can be but little affected by variations of head on values, or errors of level or time, that may also materially affect it below.

The coefficient estimated in this way is indicated by m_0, and its value is given upon the various observed curves; while m_0 upon the same curve is the constant coefficient, which is equivalent as a whole *in time* to the observed curve at this 10-foot stage. It is estimated by superimposing the data upon the group of Pl. I and interpolating the value of m that it reaches at a 10-foot value of h. While with the transparent plates of the study these data could be superimposed at will, in blue prints it is not so easy; and simply to illustrate the process a number of the curves, lettered A to F, are shown dotted upon those groups of Pls. I to IX.

But turning from the nature of this variation to actual values of it, we can not but be struck, in even a glance at the data, at the wide range that is found between different cases. Brought, as all these observations are, on to a standard-time scale, where the divergence expresses only a difference in the coefficient of efflux, we see differences, say at a stage of 10 feet, where in some cases the value is more than two and a half times as great as in others, and in making his plans, whatever purpose an engineer might have in mind here, it would seem possible that in this range he might miss his purpose by as much as 100 per cent.

It is true that this question is not now an important one with many of the locks, but it may be with some, and may come to be with others. The few minutes' delay to a single boat, even in a difference between four and eight lockages an hour, is of no great moment; but where at any time this limitation of its service may cause a block to traffic, it is a different thing, and here it begins to have a magnitude whose value can only finally be measured by the cost of a second lock.

It would therefore seem desirable to get together in small sketches to go with these data the details of the different designs for filling and emptying, and this, with such information as can be obtained of special cases like those that have been noted as requiring further explanation, will give the engineer at least a basis from which to make a fair estimate of what his lock will do.

In case any of the observations were to be repeated or a closer study of the form of the curve near the origin was to be made, the following method of observation is suggested: In the place of a gauge use the rise or fall of a barge, as in the case of the Soo Lock. This could probably be most conveniently done by reading the changes with a level from a tape suspended at the center and plumbed to a vertical. It would be best in this case to call even intervals of time—say every ten seconds—and at each call of time have the tape read and recorded. This would practically eliminate all error in the time observation and give a simultaneous observation of the stage in the lock, so far as the average of the area covered by the barge would represent it. The calling of time might begin approximately at the beginning of opening the valves (exact coincidence in the beginning is of no importance here), while at the end, as soon as motion had stopped, the man at the level should call this to the timekeeper, and the fraction of an interval there be recorded. In case there was a restricted waterway, a gauge above or below the lock should be read at intervals to give the coincident variation of head, as in the data of the Soo Lock.

With data so taken, the intervals of time reduced to the standard, and in case of any variation further corrected to a constant head of pool, as in the Soo data, when summed for total time and platted to the corresponding observed elevations, would give, in comparison with the group of curves on Pl. I, the value and the character of the actual coefficient of efflux in the lock with great accuracy, and could hardly fail to develop, in its comparison with other data, a fairly definite series of values for the coefficients corresponding to different types of design.

Since the plates were made up, several sets of observations have been received that are not included in this study, and in the process a number of locks where there was but a small lift were not considered, since between the opening of the valves and the final level there was but little data from which to determine a regular coefficient.

Very respectfully, your obedient servant,

JAMES A. SEDDON, *Assistant Engineer.*

Capt. HIRAM M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

APPENDIX M.

CEMENT TESTS BY MR. F. B. MALTBY, ASSISTANT ENGINEER.

ST. LOUIS, *May 30, 1897.*

CAPTAIN: I have the honor to submit the following report of the results of experiments made with cement to determine the adhesion of Portland and natural to each other when mixed at the same time; also the results of some experiments made with concrete bars.

Neat cement of the two different kinds was mixed separately and placed in the opposite ends of the same briquet mold.

The two cements were kept apart by a knife blade placed as near the center of the mold as possible, until the mold was filled. The knife was then withdrawn and the cement firmly pressed and rammed into the mold. Thirty-six briquets of various combinations of cement were made. They were allowed to stand in air twenty-four hours and in water six days, and then broken. Not a single specimen broke through the joint, but in every instance the break was in the natural cement, sometimes as much as one-fourth inch from the joint, showing that the adhesion of the two cements was greater than the strength of the weaker cement.

By the kind permission of Mr. M. L. Holman, water commissioner of St. Louis, the experiments were made at the city testing laboratory, at 2322 Clark avenue, by Mr. A. S. Ferguson, who is in direct charge.

The appliances and methods used are those of the best modern practice, and as all the cements used by the city in the water, sewer, and street departments are tested here, the assistants are thoroughly experienced in the necessary manipulations for making accurate tests. For these reasons I have great confidence in the reliability of the results attained.

The following table shows the breaking strain per square inch of the various specimens:

Utica and Star Stetliner.	Louisville and Star Stetliner.	Louisville and Atlas.	Louisville and Saylor.	Louisville and Medusa.
234	260	250	260	250
280	264	230	260	248
240	250	234	262	280
266	230	228	262	282
278	296	224	230	274
268	244	250	254	246
296	276			
310	266			
286				
272				
a 273	*a* 260.8	*a* 234.7	*a* 254.3	*a* 263.3

a Average.

All the Louisville was from the same mill (J. Hulme). A number of concrete bars were made in molds 6 by 6 by 27 inches long, and kept for various lengths of time. The concrete was made of cement (weighed), Osage River sand, and Osage River gravel.

The sand is a very good one, being perfectly clean and sharp, but contains possibly a little more than the ordinary proportion of fine particles; it contains 37 per cent of voids. The gravel is a very clean, hard, water-worn flint, containing 37 per cent of voids.

An inspection showed the concrete made of natural cement to be very unsatisfactory for use in constructing lock walls.

To determine the adhesion of the two kinds of concrete, several bars were made with one-half made of Portland and one-half of natural cement. The joint was made as near the center of the mold as possible, but no smooth joint was made. On the other hand, care was taken that the two kinds of concrete should interlock, and were thoroughly rammed together. All concrete was mixed with as much water as it would hold without quaking, and was thoroughly rammed with an iron rammer weighing about 10 pounds. The molds were thoroughly soaked in water before being used. They were put together with screws so that they could be taken away from the bars without disturbing them. The bars were kept moderately moist for about a week after making them, and were kept under cover from the sun for the entire time. The attached table gives the results of 15 bars which were broken. Nos. 5, 6, 10, and 13 were combination bars; none of them broke through the joint, showing that the joint was stronger than the weaker concrete. Nos. 4, 7, 11, and 12 were Louisville bars, made respectively at the same time as above combination bars, and, with the exception of Nos. 4 and 5, the combination bars were the strongest. Nos. 1, 2, and 3 are bars of Portland concrete made in theoretical proportions necessary to just fill the voids in the sand and gravel. Nos. 1 to 8, inclusive, were made of unscreened Osage sand; Nos. 9, 12, 13, and 15 of unscreened Meramec River sand, which is considerably finer than Osage sand. Some question having been raised as to the effect of fine sand, Nos. 10, 11, and 14 were made of sand screened to pass a No. 20 and be retained on a No. 30 screen. No. 15 is a bar made of Portland cement in proportion of 1-4-9.5.

The proportions given are for parts of packed cement weighing, for natural, 75 pounds, and for Portland, 104 pounds per cubic foot, and for parts of loose sand and gravel. It is realized that a much larger number of tests should be made in order to draw any definite conclusions as to the relative strength of various cement concretes, but it is hoped that the list attached may be of some value.

Very respectfully, your obedient servant,

F. B. MALTBY, *Assistant Engineer.*

Capt. HIRAM M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

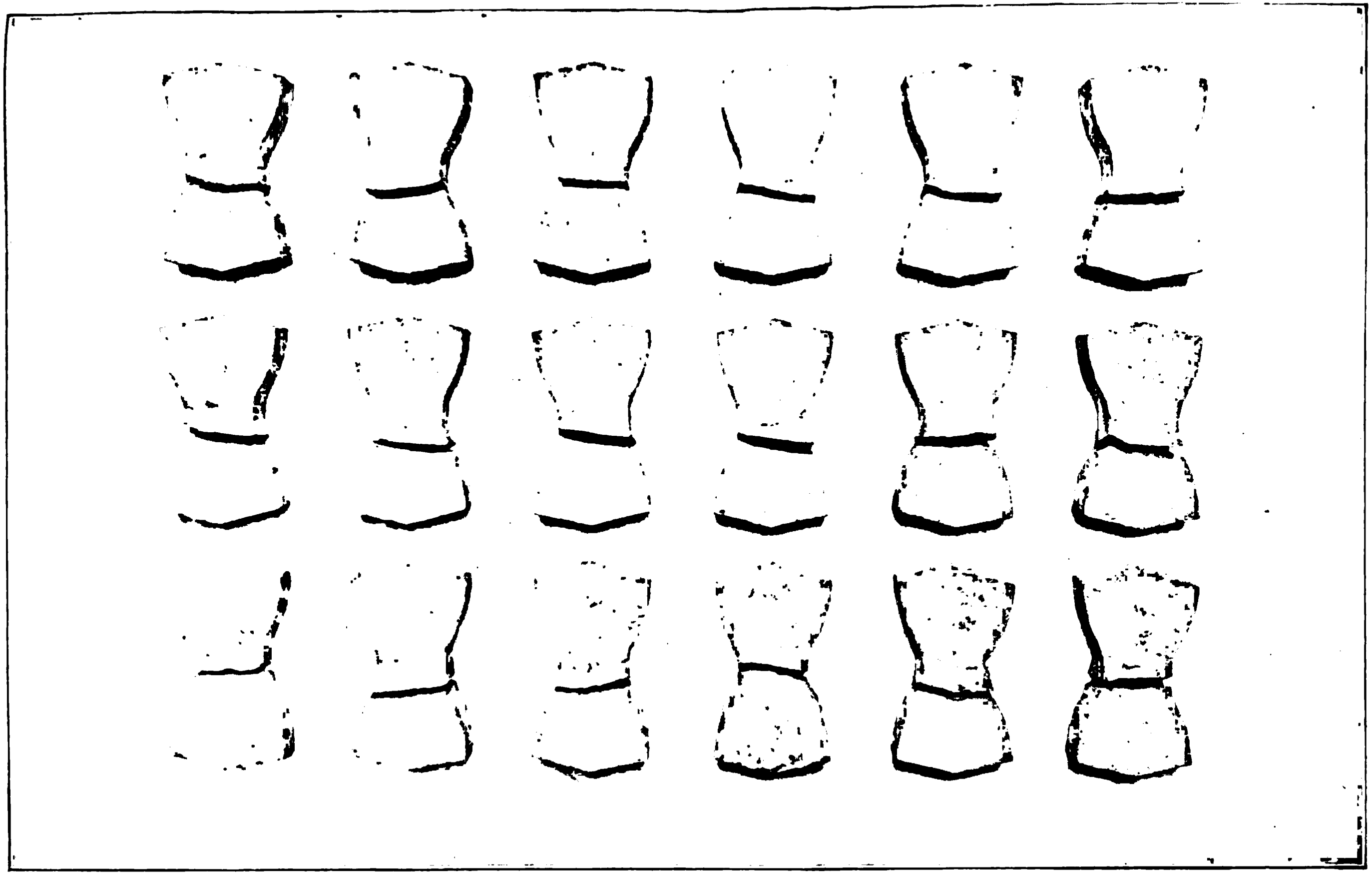


PLATE ILLUSTRATING CEMENT TESTS.

Upper half of briquets imported Portland; lower half of briquets native natural. Nos. 1 to 10, inclusive, Alsen [imported Portland] and Utica, Ill. [natural]. Nos. 11 to 18, inclusive, Alsen [imported Portland] and Louisville, Ky. [natural].

Tabular statement of strength of various concrete bars.

[All bars were made 27 inches long, supported 24 inches apart, load applied at center.]

Number.	Date made.	Date broken.	Age.	Proportionate parts.			Kind of cement.	Section broken, width by height.	Center breaking load.	Modulus of rupture. $f=\frac{3}{2}\frac{wl}{bh^2}$	Remarks.
				Cement.	Sand.	Gravel.					
	1897.	1897.	*Days.*					*Inches.*			
1	Mar. 23	Apr. 16	23	1	2.4	68	Alsens......	6 ×6	676	113	
2	....do ...	....do ...	23	1	2.4	68	.....do	6 ×6	2,000	333	
3	Apr. 12	....do ...	4	1	2	5	.....do	6 ×6	570	95	
4	....do ...	....do ...	4	1	2	3.65	Louisville ..	6 ×6	260	43	
5	....do ...	....do ...	4	1	2	3.65	.....do	6 ×6	170	28	Combination bar, one end Louisville, one end Portland, did not break at joint.
				1	2	5	Alsens......	....	....	....	
6	....do ...	Apr. 26	14	1	2	3.65	Louisville ..	6 ×6¼	303	47	Combination bar. Broke 2 inches from joint. Osage sand.
				1	2	5	Alsens......	....	....	....	
7	....do ...	....do ...	14	1	2	3.65	Louisville ..	6 ×6⅛	243	34	
8	Apr. 13	....do ...	13	1	2	3.65	Milwaukee .	6 ×6	74	12	Osage sand.
9	....do ...	....do ...	13	1	2	5	Alsens......	6 ×6	1,269	211	
10	Apr. 23	May 7	14	1	2	3.65	Louisville ..	6¼×6¼	378	56	Combination bar. Broke 4 inches from joint in the weaker concrete. Standard sand.
				1	2	5	Medusa.....	....	....	....	
11	....do ...	....do ...	14	1	2	3.65	Louisville ..	6¼×6⅛	148	20	Standard sand.
12	....do ...	....do ...	14	1	2	3.65	.....do	6⅛×6⅜	130½	19	Meramec sand.
13	....do ...	....do ...	14	1	2	3.65	.....do	6⅜×6⅜	205⅛	37	Combination bar. Broke 4 inches from joint in the weaker concrete. Meramec sand.
				1	2	5	Medusa.....	....	....	....	
14	....do ...	....do ...	14	1	2	3.65	Milwaukee .	6⅜×6⅜	75	15	Standard sand.
15	Apr. 26	May 10	14	1	4	9.5	Medusa.....	6⅛×5⅛	580⅛	130	Meramec sand.

APPENDIX N.

ANNUAL REPORT OF MR. L. P. BUTLER, ASSISTANT ENGINEER.

ST. LOUIS, MO., *December 5, 1896.*

CAPTAIN: I have the honor to report on the work of improving the Gasconade River during the fall of 1896.

In the office there were platted thirteen sheets and an index sheet from the notes of the survey of the Gasconade River in 1895. These sheets represent 29.5 miles of river between Indian Head and Arlington, Mo. They are platted with soundings and profiles, and are all inked with the exception of hachures and cultivated land, which are indicated in pencil.

The accumulation of materials at the mouth of the river was begun October 31. The construction of a barge was begun September 1 and completed September 19.

The barge built is 50 feet long, 15 feet 10 inches beam, and 19 inches deep. The deck, bottom planking, and gunwales are of yellow pine; the frames, bracing, and all inside work of white pine; and the end blocks and nosing of oak. It was designed for carrying rock over shoal water, and for that reason was built shallow, which necessitated a longitudinal bulkhead. It was only required in loading that the greatest weight be put at the ends. It was fitted with one Providence hand capstan.

While the barge was being built a force was put to work quarrying rock and getting out logs at Bocks Bar. This work was completed when the barge was ready for use, and the quarry force was sent to Woodpecker Island while a separate force was engaged in the construction work at Bocks Bar.

The season's field work consisted in the construction of dikes to direct the water at shoals and in the removal of snags.

The dikes are built of cribs filled with rock and backed with rock on either side. The backing on the pocket side of dike is laid on willows. The cribs are built of 20-foot logs with cross pieces 3 feet from each end, notched in. The width of cribs is 5 feet inside. The logs are from 6 inches to 10 inches in diameter, and the notching does not close the spaces between them by from 4 inches to 6 inches, so that a crib of four logs on a side is about 4 feet in height. The logs are drift bolted together at the four corners of each crib, three-fourths inch square drift bolts being used at first, and afterwards three-fourths inch round with upset heads. At the center of each crib there are three 4-inch cross sticks notched into and spiked to the lowest longitudinal logs, forming a narrow floor, intended to assist in sinking the crib. Stakes were driven 5 feet apart in the line of the down-stream side, or current side, of the proposed dike. The cribs were built on the shore and dragged, with the aid of the current,, to place against the row of stakes. Where, as was the case at Woodpecker Island, some of the cribs were 6 feet high they were built on a barge and launched from it into place. The cribs could not be floated to place without the assistance of current unless they were low, as the logs used were heavier than water. The cribs when in place were filled with rock, one-man size being used, finished with smaller rock on top. Willows were forced to the bottom against the up-stream side, or inclosing side, of dike, and rock placed on them. Rock was also placed on the down-stream or current side of dike, piled nearly to the surface of the water and sloping naturally.

Bocks Bar, 2½ miles above the mouth.—This is the first shoal from the mouth of the river over which there is a marked fall. Just below the mouth of First Creek, 1 mile from the mouth of the Gasconade River, there is rather shoal water; but at a low stage there is no appreciable fall and the point has not been reported, within my knowledge, as being troublesome.

At Bocks Bar there had been built, some years ago, a dike from the right bank, extending to within 120 feet of the present left bank and ending in a 75-foot spur upstream. This season there was shoal water just above the end of the spur. The water was not as low, however, as in November, 1895, at which time there was a bar out of water immediately above the end of the spur, and the main body of water flowed between it and the spur, whipping around the latter in a direction nearly at right angles to the direction of the stream above and below.

The work done at this point consisted in building a dike as an extension to the existing spur, running it directly upstream, and in making repairs to the old dike. The new dike is 260 feet in length. The height varies from 2 feet to 5 feet, its top being about 1 foot above the level of the water in the pocket at the stage of water of the time of building, which was moderately low. The last crib was placed at an angle of 30° with the direction of the first 240 feet of dike, forming a funnel-shaped entrance for the water into the channel made between the bank of the river on the left and the dike, followed by the bar, on the right. This channel is 100 feet in width for a length of 900 feet. Below this the channel widens to 150 feet when the end of the bar and quiet water is reached. The fall in the first 330 feet was 1 foot September 9, 1896, the total fall from pool to pool, a distance of 1,600 feet, being 1.2 feet. October 19, 1896, the fall in the first 330 feet was 1.1 feet, and the fall from pool to pool 1.5 feet.

Bocks Bar being the first point above the mouth of the river at which there is a marked fall, the fall here depends upon the stage of water in the Gasconade River and in the Missouri, so that often there is no fall at Bocks Bar, owing to backwater from the Missouri River. At a low stage of the Missouri the water of the Gasconade flows through the channel at Bocks Bar with great velocity. The shoal forms a natural dam, holding the water in the river above. In the improvement of this shoal, as in every other, the idea was to maintain this dam system and merely direct the water through one channel, lessen the slope by distributing the fall over a greater length, and gain the greatest depth possible for the quantity of water it was practicable should flow. Too great a quantity flowing over any one shoal would lower the water in the pool and on the shoal above.

Steamers are obliged to use a line over Bocks Bar when the Missouri River is low.

There were used on the new dike 170 cubic yards of rock, and in repairing the old dike 22 cubic yards of rock.

Woodpecker Island, 11 miles above the mouth.—At this point, several years ago, there was a wooded island in the river with apparently an equal volume of water flowing on either side. The left bank channel had been cut off by a dam. The island, which was wooded, was wearing away at the time the dam was built and now is a gravel bar. There is a small break round the end of the dam, but the right bank channel, though swift, contains good water until the foot of the bar is reached, when it comes against the main left bank of the river and again leaves it to break into four channels separated by gravel bars.

The work done at this point consisted in cutting off the two right bank channels by a dike or wing dam running from the right bank of the river, which is the left side of another island, diagonally upstream to the central bar. This dike is 560 feet in length. The depth for 200 feet midway is 6½ feet, the depth for the remaining length varies from 6½ feet to 2 feet, the last 60 feet being built on the bar, at the time out of water. On these last 60 feet willows were laid, forming a mat as a bottom to the cribs and extending on both sides, before the rock was placed. The falling leaves, drifting into the pocket formed by the bank and the dike, were filling the crevices in the dike and rapidly making it tight at the time of leaving it. The resultant channel enters on the left of the point of the dike and follows it until deep water is reached.

Six hundred and seventy-five cubic yards of rock was used in this dike. The fall here from pool to pool, a distance of 3,400 feet, was 2.5 feet, October 6, 1896.

Stake Shoal, 9 miles above the mouth.—At this point the channel is straight. The water leaves the quiet pool above, enters between two gravel bars, and flows over the shoal at a width of 250 feet and for a length of 1,300 feet before the pool below is reached. The aim at this point was to narrow the entrance of the water onto the shoal and to train it along a longitudinal dike until the pool below was reached. A dike was begun on the right bank near the foot of the shoal, and carried upstream 200 feet, complete except as to backing. The project calls for 1,100 feet, which would carry the dike to the head of the shoal. There were logs prepared for 600 feet of crib work, and 100 cubic yards additional rock was quarried. The fall at this shoal from pool to pool, a distance of 1,300 feet, is 1.7 feet.

Removal of snags.—Snags were removed during the season from Pryors Bend and points below. Bryors Bend is a stretch of river 3 miles in length, the lower end of which is 30 miles from the mouth of the river. It is difficult of navigation, particularly to rafts, on account of its circuitous course, the swift current, due to a fall of 7 feet in its length, and to the snags which lodge more easily in the bend than at any other point on the river.

The total number of snags removed was 91, of which 82 were taken from Pryors Bend. There were 10 overhanging trees cut and 20 drift trees cut.

The snagging party was in the field from October 20 to November 12, operating twenty-one working days.

Surveys were made at Bocks Bar, two; Stake Shoal, Woodpecker Island, Upper Turnpike, and Brandts Shoal.

Cost of building barge	$391.26
Cost of dike construction	$1,773.09
Cost of removal of snags	$261.44
Cost of surveys	$22.37
Total quantity of rock quarried .... cubic yards..	1,077
Cost of quarrying rock, per cubic yard	$0.6013
Total number of linear feet of dike built .... feet..	1,020
Cost of dike construction, per linear foot	$1.7383

Table of expenditures.

	Labor.	Materials.
Quarrying 1.077 yards rock	$611.91	$35.71
Constructing 1,020 feet dike (less rock)	1,102.00	83.60
Constructing barge	140.19	251.07
Removing snags	242.25	19.19
Repairing plant	5.25	....
Supplies used	....	4.49
Materials on hand	....	73.56
Moving plant	78.87	....
Surveys	22.37	....
Superintendence	449.00	....
Office work	182.00	....
Care of plant	91.50	....
Construction incidentals	91.56	....
	3,016.90	....
August pay roll	128.14	....
Total labor	3,145.04	....
Hire of barge	....	30.00
Towing barge	....	5.00
Traveling expenses	....	6.55
Materials purchased	....	158.38
		667.55
Labor	....	3,145.04
Total expenditure	....	3,812.59

Very respectfully, your obedient servant,

L. P. BUTLER, *Assistant Engineer.*

Capt. H. M. CHITTENDEN,
Corps of Engineers, U. S. A.,
Secretary Missouri River Commission.

PROJECT FOR CONSTRUCTION OF LOCK AND DAM NO. 1, AT BRENNEKES SHOAL, OSAGE RIVER, MISSOURI.

MISSOURI RIVER COMMISSION,
OFFICE OF THE PRESIDENT,
St. Louis, Mo., May 18, 1897.

GENERAL: I have the honor to transmit herewith a complete project* for the construction of Lock and Dam No. 1, Osage River, Missouri, submitted by Capt. H. M. Chittenden, which has been approved by the Missouri River Commission in all of its general features, reserving decision upon the plans for operating machinery and the kind of cement to be used in concrete constructions until a later date, and leaving to Captain Chittenden's discretion the details of construction.

Approval is respectfully requested.

Very respectfully, your obedient servant,

AMOS STICKNEY,
Lieut. Col. of Engineers,
President, Missouri River Commission.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
May 24, 1897.

Respectfully referred to The Board of Engineers for examination, report, and recommendation.

To be returned.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

[Second indorsement.]

THE BOARD OF ENGINEERS,
New York City, June 24, 1897.

Respectfully returned to the Chief of Engineers, with report of The Board of Engineers, dated June 23, 1897.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Senior Member Present.

PROJECT OF CAPT. HIRAM M. CHITTENDEN, CORPS OF ENGINEERS.

The revised project for the construction of Lock and Dam No. 1, as at present approved by the Missouri River Commission and the Chief of Engineers, covers only the following points:

(1) Dimensions of lock, 220 by 42 feet.
(2) Use of concrete in construction.
(3) Lower miter sill fixed at reference 94 feet.

The completed project for the lock as herewith submitted covers the following additional points:

(4) Reference of upper miter sill 103 feet.
(5) Filling valves to be in miter sill wall under gate. (Pls. III, V, VI.)
(6) Emptying valves in lower gate. (Pl. VII.)
(7) Top of main walls at 120 feet.
(8) Top of head walls at 128 feet (above flood height).

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*Drawings not printed.

(9) Foundation on piles; timber grillage under walls; concrete floor 3 feet thick under chamber, with piles (4 feet centers) cut off even with top surface, and notched to make good contact with concrete. (Pl. III.)

(10) Underflow in river bed to be cut off by Wakefield piling under miter wall down to reference 75 feet, or by such other means as may be found most effective when work is done.

(11) Foundation to be drained so as to relieve any possible leakage from upper pool.

(12) Sections of walls, and all other details, as in drawings. (Pls. III to VII.)

PROJECT FOR DAM.

(13) The dam is to be built in ten 75-foot sections, separated by 9 piers, 10 by 30 feet at base, with tops at reference 120 feet. (Pl. II.)

(14) The dam is to rest on a pile foundation and is to consist of a fixed weir and a movable crest. (Pl. VIII.)

(15) References: Top of foundation, 97.5 feet; top of fixed weir, 109 feet; crest of movable dam up, 116 feet.

(16) The underflow of the river is to be cut off, if possible, down to reference 75 feet, the same as under the lock.

(17) Materials are wood, iron, and concrete.

(18) Details and general plans as in drawings. (Pls. VIII to XIII.)

DETAILED DESCRIPTION OF LOCK.

Length over all, 275 feet 3 inches.
Length between quoins, 220 feet.
Breadth of foundation, 76 feet.
Width of lock chamber, 42 feet.
Height of main lock walls, 27 feet.
Height of head walls of lock, 35 feet.
Thickness of head walls, 16 feet.
Thickness of foot walls, 14 feet at base, 11 feet 9 inches at top.
Thickness of main walls, 14 feet at base, 5 feet at top.

Foundation rests on piles. Beneath the walls the piles are 3½ feet apart. Upon them is placed a timber grillage, consisting of 10 by 10 inch yellow pine timbers, surmounted by a floor of 4-inch oak plank. Between the walls, forming the floor of the lock, is a layer of concrete 3 feet thick. It extends 2 feet under the walls. The piles under the chamber are cut off level with the floor of the lock and the concrete is put in between them. The piles are notched in order to afford a more secure hold for the concrete. The concrete has a bearing surface of about 9 square feet on each pile and the piles are spaced 4 feet from center to center. It is believed that any upward pressure beneath the concrete would have to pull the piles before it could move the floor.

The necessity for this floor is to prevent leakage from the lock when the water within it stands above the level of the lower pool, and to prevent leakage into the lock should it become necessary to pump out the interior for repairs.

All leakage from the upper pool is cut off, as far as possible, by a row of Wakefield piling beneath the upper miter sill wall, extending down to reference 75 feet, the reference of the lock floor being 93 feet. But the nature of the river bed is such that water will find its way under considerable pressure to the ground under the lock. To prevent any evil effects from this pressure the foundation is thoroughly drained. Immediately below the concrete of the foundation is a natural layer of heavy clay from 1 to 2 feet thick. Beneath this is water-bearing gravel, which is the place where the water pressure will develop. To relieve this pressure a trench will be let down into this layer just below the row of sheet piling (see drawing), and will be filled with broken stone. It will communicate with a drainpipe extending along the lock wall on the shore side and with the lower pool on the river side. Along each side of the lock, at intervals of 30 feet, holes about 2 feet in diameter will be sunk into the gravel stratum and cased with sewer pipe. These will communicate on the shore side with the drainpipe and on the river side with the lower pool. By this means any tendency to develop pressure beneath the foundation is prevented, for relief is at once given through this connection with the lower pool.

The lock is to be filled through six culverts in the upper miter-sill wall. They are closed by wickets at their upper end, three being operated from each side on a single axis. The drawings make these details clear. The cross-section area of the filling culverts is about 61 square feet, calculated to fill the lock with a lift of 16 feet in three minutes, including time of opening valves. The space above the culverts is protected from drift by a grating.

The lock is to be emptied through wickets in the lower gates similar to those now in use on the Kanawha River.

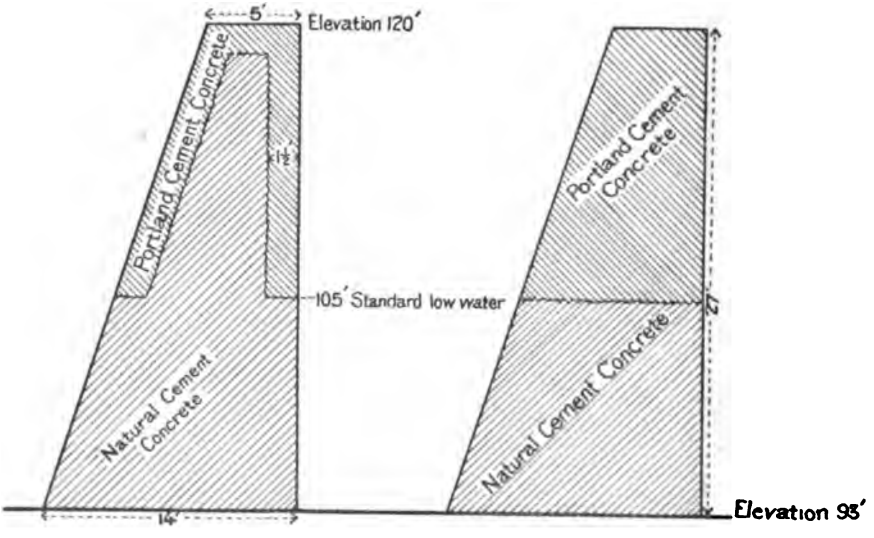
The head walls of the lock are carried up to 128 feet, so as to act as a guard in time of flood and prevent a current through the lock.

The gates are similar in general design to those in use on the Kanawha River, and present no features of special importance.

Through the upper miter-sill wall are carried the pipes for operating the movable dam. (See description of dam.) The inlet culvert and valve for filling the chamber of the first section of the dam is in river wall of the lock opposite the upper gate. (See drawing.)

All other details, it is believed, are fully illustrated in the drawings.

In the matter of the choice of cement for use in the concrete masonry, it is requested that the final decision be left open until certain experiments described below can be made. It is proposed to use both Portland and natural cements for this work. For all that portion of the masonry below standard low water (105 feet) a good natural cement will be used. This portion of the work, being subject neither to the action of frost nor to the abrasion of boats, nor, to any considerable



extent, to the action of currents, the qualities of hardness and strength are of secondary importance. Mass being here the desideratum, there is no reason to doubt that a natural cement concrete will answer every purpose.

For that portion of the walls above 105 feet one of the two arrangements shown in the accompanying cuts is proposed. If experiments now in progress show that a section along the general line of union of the two kinds of concrete possesses a strength equal to or greater than the weaker concrete, then the arrangement in Cut (1) is recommended. If, on the other hand, it results that such a joint is weaker than a similar section of natural cement concrete, the arrangement shown in Cut (2) is proposed. Very careful experiments with concrete blocks are now in progress, and will be continued until it is settled whether or not a good bond can be secured between contiguous masses of Portland and natural concretes when deposited at the same time.

The saving in cost by the use of natural cement will be considerable. If the lock were built all of Portland, it would cost $20,000 more than if all of natural cement. If built on the plan of Cut (2), it will cost $9,000 more than if all of natural cement. If built on the plan of cut (1), it will cost less than $3,000 more than if all of natural cement.

It is therefore recommended that the arrangement shown in Cut (1) be approved, subject to the results of pending investigations, and that, if these results are unfavorable, then the arrangement shown in Cut (2) be adopted.

THE DAM.

Necessity for a movable structure.—The reason which led to the adoption of a movable dam for the site of Lock No. 1, Osage River, was that the high-water cross section at this point may be contracted as little as possible. In order to make the pool of the dam extend to the most favorable point for the construction of Lock No. 2, should such a lock ever be built, the crest of the dam should stand not lower than 116 feet. The contraction of waterway resulting from a fixed structure of this height would be such as to cause a rise in the flood plane above the lock of 3.08 feet above its level in the natural condition. (Pl. XV.) With a movable dam, as proposed, this rise in the flood plane is reduced to less than 1 foot. The topography of the valley above the dam is such that a difference of 2 feet in the flood plane of the river will represent a considerable acreage of overflow, and the damages which such an overflow would represent would probably be much greater than the extra cost of a movable dam over that of a fixed structure.

Detailed description of dam.—The dam rests on a pile foundation (Pl. VIII), surmounted by a timber grillage on which rests a watertight floor of 4-inch plank. The second row of piles on the upstream side consists of triple-thickness sheet piling reaching entirely across the river on a line with the sheet piling under the lock. It extends downward to reference 75 feet and will cut off the underflow of the river for 25 feet beneath the river bed. The foundation of the dam proper is 25.5 feet broad, and the structure forming the apron of the dam, also resting on piles and joined to the main foundation, is 16.5 feet wide, giving a total breadth of base of 42 feet.

The greatest possible relief of the dam, or difference in elevation between the upper and lower pools, is 16 feet. This, however, as explained in the discussion on the strains of the gate, can very rarely occur. In fact, when the present work of opening a direct connection between the Osage River and the Missouri near Cote Sans Dessein is finished, the lower pool can not fall below 105 feet during the navigation season, giving a relief of only 11 feet. In the preparation of these plans, however, and in determining the strains upon the gate, a possible maximum relief of 16 feet has been assumed.

Upon the foundation just described rests an iron framework consisting of two parts, MLNOPD and DEFG, which, with the concrete mass HIJK, forms the fixed weir. The arrangement of these frames is shown in detail in the drawings. The frames DEFG occur every 5 feet. The frames LMNOPD occur every 2½ feet.

The frame LMNOPD forms the lower wall of the chamber AZQ and sustains the pressure on the concave surface D^{1}Q. It also supports the upper end of the apron RR^1; and, when the gate is closed for repairs, it supports also a part of the weight of the gate and the pressure on the bulkhead VWX.

The frame DEFG supports the movable part of the dam and forms the upper wall of the chamber. The wooden partitions D^{1}Q and E^{1}Z are water-tight.

The concrete mass HIJK forms the impervious barrier of the fixed weir and supplies the weight necessary to the stability of the whole structure.

The apron of the dam, like the main structure, rests upon piles, and is not liable to undermining from the agitation of the water below the dam. Its construction is fully illustrated by the drawings. The space beneath it is left vacant, except as filled with backwater from below, or with the sediment that may collect there. The escape of water from the chamber at Q and from the interior of gate at B passes into this space.

The superstructure, or movable portion of the dam, is a sector of a circle in cross section. The arc subtended is 67° 30′. It consists of an interior iron framework A′ B′ C′, with a wooden exterior ABC. The upper face AB is air-tight, the lower face is water-tight, and the cylindrical face is air-tight about two-fifths of the distance from C to B. The ends of each section of the gate are closed and air-tight from C down to a line shown in fig. 2, Pl. XIV. The gate is held by the hinge A, of which a full-sized drawing is given on Pl. IX. When the gate is in operation it is supported by water pressure and by the pin A. When not in operation it falls into the chamber AZQ and rests against the stop Z. The other details of the structure are readily understood from the drawings.

The triangular space DEH is a longitudinal culvert by which water is conveyed to or from the chamber AZQ. In order that the pressure of the water may be applied to or withdrawn from the face AB of the gate uniformly throughout its entire length, the connection between the chamber AZQ and the culvert DEH consists of a narrow opening, ZQ′, extending the entire length of the gate. Its entire area slightly exceeds that of DEH.

The piers (Pl. XI) separating the sections contain the culverts and valves by which the supply of water to the chamber AZQ is controlled. A rectangular culvert 3 by 4 feet enters centrally from the upper end of each pier and passes out at the lower end. It is intersected at the center of the pier by a cross culvert of trapezoidal cross section, but of the same area. A heavy iron girder, embedded in concrete at the ends, cuts both culverts in two diagonally at their junction, so as to restrict communication through the upstream culvert to the chamber to the right of the pier, and that through the downstream culvert to the chamber to the left of the pier. The culverts are closed by sliding valves operated by oil cylinders actuated from shore.

The operation of the gate is as follows: The outlet valve being closed, the inlet valve is opened. The head of the upper pool is brought to bear on the lower surface AB of the gate. As shown in the discussion on the strains in the gate, there is always a sufficient head to raise the gate except in a certain contingency to be considered further on. As the gate rises and approaches its normal position when up, it is not brought to rest by a stop, but by closing the inlet valves, or, automatically, by the escape of water at Q′. RQ is a gate 2½ feet long. (Pl. X.) There are seven of these to each section. Their combined free space for the flow of water is about 10 square feet. The area of the inlet culvert is 12 square feet. When Q′ passes above Q, water begins to escape, and the outflow increases the farther the gate rises. By the time Q′ reaches R the outflow through the gate, with the leakage at other points, will fully equal the inflow, and the gate will cease to rise. By gradually closing the inlet valve the gate will settle back to its normal position when Q′ is just below Q. The valve is then left in this position, and the friction of the gate will preserve a balance of forces. Ordinarily the gate would be stopped by the operator when it has reached its normal height, but in case of inadvertence or carelessness no harm can result, for the gate will come automatically to rest without shock or sudden stop, as just explained.

The contingency already referred to, when there will not be sufficient initial head to raise the gate, is fully considered in the discussion on the strains in the gate. The air necessary for the expulsion of sufficient water from the interior of the gate to give it the requisite buoyancy to rise in still water is supplied through a 2-inch pipe leading from each section to an air pump on shore. These pipes, with those conveying oil to the valve cylinders, are buried in the concrete mass, as shown in the drawings. The operating room, or house to cover the air and oil pumps, will be located close to the head walls of the lock on the shore side.

For the purpose of making repairs to any section, the bulkhead VWX (Pl. VIII) may be erected, supported by the frame DEFG and by the gate through the struts CX and SW. The gate is supported at A and by braces resting on the apron and against the circumference of the gate. By closing the upper valve and opening the lower, the structure is uncovered down to the level of the lower pool. By closing the lower culvert also and applying a pump, the entire structure is rendered accessible.

The gate will never be kept up after the upper pool reaches stage 120 feet. The piers will not form obstructions to drift, as drift does not begin to run in the river until they are entirely submerged. At such times their location will be marked by buoys for the information of pilots.

The cost of the dam, with a liberal allowance for every item, is a trifle under $120,000, or $140 per linear foot.

For a comparison of the probable cost of this form of gate with that of other forms, the following examples are cited:

Dam at Lock No. 7, Great Kanawha River.—(Authority, Col. Peter C. Hains, Corps of Engineers.) Elevation of bed of river, 535 feet; low water, 539.6 feet; crest of dam, 550.5 feet; type, Chanoine wicket; cost, $270 per linear foot. The relief of this dam, both above low water and above the bed of the river, is very nearly the same as at Lock No. 1, Osage River.

Lumbermen's dam in Minnesota.—(Authority, A. O. Powell, United States assistant engineer, who prepared the estimates.) Common bear-trap type; head of dam, 10 feet. Estimated cost, $280 per linear foot.

Big Sandy River, Kentucky.—(Authority, Board of Engineer Officers—Craighill, Lockwood, Turtle.) Type, Poiree needles; length of dam about 300 feet; clear height of crest above sill of navigable pass, 13 feet; estimated cost, $93,029.25. (Annual Report Chief of Engineers, 1892, p. 2108); cost per linear foot, $310.

HIRAM M. CHITTENDEN,
Captain of Engineers.

REPORT OF THE BOARD OF ENGINEERS.

THE BOARD OF ENGINEERS,
New York City, June 23, 1897.

GENERAL: In reply to your indorsement of May 24, 1897, The Board of Engineers has the honor to state that it has examined the project submitted by Capt. H. M. Chittenden, Corps of Engineers, for the construction of Lock and Dam No. 1, Osage River. This project was forwarded with request for your approval by Lieut. Col. Amos Stickney, Corps of Engineers, president of the Missouri River Commission, with the statement that the Commission had approved it in all of its general features.

In examining the project and making its recommendations The Board of Engineers has acted with the understanding that its opinion has been requested solely upon the novel features of the dam proposed and not upon the question whether the improvement as a whole is a desirable one, nor upon points of foundations, levels, material, etc., upon all of which no opinion can be formed without a personal knowledge of the locality. From the action of the Missouri River Commission it may safely be assumed that the constructive details are suited to local requirements.

As stated in the memoir descriptive of this project (see page 3949), a dam 16 feet in height above extreme low water in the lower pool is necessary in order to pool the water to the required distance upstream. A fixed dam is not regarded as desirable since it would unduly raise the flood level above. On this account Captain Chittenden recommends a dam consisting of a fixed concrete portion 9 feet high supporting a movable portion which can be raised by the hydrostatic head to the full height of 16 feet above extreme low water below. The movable portion is a novel modification of the drum weir. A detailed description is given in the memoir and the accompanying illustrative plate (see page 3947). The whole dam relies for its stability mainly upon the concrete mass of the fixed portion, which rests upon a flooring supported by piles and grillage. With proper care in construction to insure no leakage between the concrete and floor, this part of the dam possesses ample stability against overturning. Proper precautions against sliding can readily be taken.

The movable dam is built in lengths of 75 feet, separated by piers in which the valves of the operating culverts are placed. Captain Chittenden states that it can be raised by a head which is normally obtainable at times of low water, and estimates that it will respond to a pressure of less than 1 foot. In the unusual case of its being drowned by backwater from the Missouri at times when the discharge of the Osage is small, provision has been made to raise it mechanically by pumping air into the drum. The pipe through which the air is pumped has a diameter of 2 inches, and must serve not only to convey the air under pressure to raise the drum, but to relieve the internal pressures by letting air in and out when the gate is worked by the hydrostatic head. It is believed that there is but one such pipe for each section of the dam 75 feet long. It is possible that freer communication for the air should be provided in order to allow sufficiently quick and easy operation. This fact will be developed in the experiments which are proposed.

Captain Chittenden states that a model on a scale of one-third natural size has already been built, and has worked satisfactorily. He states further that should his plans meet with approval a short section of full size will be built at the sight of the dam to develop any latent defects in the design. The Board of Engineers considers the dam sound in principle and especially well adapted to a locality where it may be placed on the crest of a fixed weir to increase the height of the latter. For such service it preserves to a great degree the advantages of the drum weir while avoiding its one notable disadvantage, that of the deep and expensive foundation usually necessary. Accepting Captain Chittenden's estimate of say $140 per linear foot as accurate, the cost of the dam as proposed will not be greatly in excess of a reasonable estimate for a fixed dam of similar relief and foundation, while much below the ordinary cost of a movable dam.

The Board recommends the design of the dam for approval, and considers it advisable that experiments should be made with a full-sized model, as proposed by Captain Chittenden, before undertaking the final construction.

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.
JOHN G. D. KNIGHT,
Major, Corps of Engineers.
H. F. HODGES,
Captain, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

NOTE.—The project as recommended by the Missouri River Commission and by the Board of Engineers was approved by letter of the Chief of Engineers, dated June 29, 1897, with the understanding that experiments will be made with a full-sized model before final construction is undertaken.

ESTIMATES.

REVIEW OF PREVIOUS ESTIMATES AND TABULATED STATEMENT UPON WHICH PRESENT ESTIMATE IS BASED.

Inasmuch as the final estimate of the cost of Lock and Dam No. 1, Osage River, as submitted with the present revised project, is apparently largely in excess of previous estimates, it will be of interest to present a condensed summary of the earlier estimates.

The first of these estimates appears in Major Miller's project dated May 14, 1891.

Lock.—Length over all, 339 feet 6 inches; length between quoins, 275 feet; width, 50 feet; lift, 8 feet 6 inches

Dam.—A timber and rock structure of 11.5-feet lift.

Cost of lock and dam, $187,244.

This project was modified somewhat on the recommendation of General Comstock, and the above estimate was increased to $200,000 (Annual Report Chief of Engineers, 1892, p. 1742).

The first important revision of this estimate occurred in 1894, when the whole subject of the Osage lock and dam was exhaustively reviewed by a committee of the Missouri River Commission, consisting of Major Allen, Corps of Engineers, and Mr. R. S. Berlin, in a report to the Commission dated September 22, 1894. (Published in minutes of Commission meeting of November 28, 1894).

The lock considered was to be of the following description:

	Ft.	In.
Length over all	340	6
Length between quoins	276	0
Width of chamber	52	0
Lift	10	6

A needle dam was also provided for. The following extract from the committees report will show their estimate of the cost of this work:

"Estimated cost of the lock, including lock keeper's dwelling, etc., according to best information at present attainable, $216,000.

"The cost of the dam has not yet been figured, but it seems safe to assume that it will be sufficient to bring the total cost of lock and dam and appurtenances to about $300,000, though these figures may be modified one way or the other after proposals are received for building the lock."

This estimate does not seem to have been adopted by the Commission, because in the Annual Report the probable cost of the lock and dam is thus stated:

"Based on such data as we now have, it appears that the probable total cost of the lock and accessories will be about $190,000, and of the dam about $75,000, or a total of $265,000 as against the estimate of $200,000 submitted in 1892. For reasons above given this latter estimate could only be regarded as approximate."

The "reasons" here referred to relate to a preceding paragraph in the same report, viz:

"In November, 1894, a plane-table survey was made from the site selected for the lock and dam to a point about 30 miles above to ascertain the additional amount of land that would be overflowed, due to a stationary dam of 10.5-feet lift, should the river reach the highest recorded flood stage. The results of this survey showed that such a dam would, at the above stage, cause an additional overflow of 636 acres within the limits of the survey, or an increase of about 20 per cent in area of land flooded. In view of these results, the Commission decided, February 11, that a modification of the plans of the dam to provide for a stationary dam of less lift than 10.5 feet, and upon this a low, movable dam to bring the lift to 10.5 feet when raised, would be advisable. It is proposed during the current season to make a complete examination of the site of the dam, and to prepare new plans and estimates of cost in accordance with the above decision."

The dam provided for in the above $75,000 estimate was for a movable crest of only 2½ feet lift, estimated to cost only about $11,000, and was in no sense a comprehensive project such as was contemplated in the report of the committee above referred to.

In January, 1895, an additional estimate was prepared for a movable dam, the type considered being the Chanoine wicket. This estimate was $182,500. Substituting this figure for $75,000 would give, as the estimated cost of the lock and a movable dam, $372,500. It will thus be seen that no estimate for a lock and a movable dam of any comprehensive pattern has ever been below $300,000. None of these estimates, however, were ever acted upon.

Subsequent to the date of the Annual Report for 1895 it developed that the foundation of the lock would have to be lowered about 5 feet for reasons fully explained in the present revised project and accompanying papers. As nearly as can be determined from the correspondence on the subject, an estimate of the additional cost which this change of plan would involve was about $45,000. With this additional cost the foregoing estimates of $300,000 and $372,500 would become $345,000 and $417,500, respectively.

The changes authorized in the partial project approved by the Chief of Engineers November 23, 1896, viz, a diminution of the size of the lock and a substitution of concrete for rock masonry in its construction, as well as the proposed adoption of a less expensive type of dam, will materially reduce the above estimated cost. The work has now progressed far enough to make possible a very close estimate for the entire work. This is given below:

Cost of lock.	
Expended to March 31, 1897	$117,495.10
Uncompleted work.	
Cost of masonry and foundation (see detailed estimate attached)	55,986.08
Cost of fixtures, appurtenances, and miscellaneous expenditures pertaining to lock	19,224.70
Dam.	
Cost of entire structure	119,763.69
Total	312,469.57

As a safe amount covering all contingencies, the sum of $325,000 is considered amply sufficient for the construction of the lock and dam and accessories, and this sum is submitted as the final estimate of the total cost of the work. There is now available the sum of about $62,000, and as the estimated cost of completing the masonry of the lock is about $56,000, it is hoped to accomplish this part of the work during the coming season.

Estimate of cost of completing concrete masonry of Lock No. 1, Osage River, Missouri.

Pumping		$4,000.00
Excavating		2,500.00
Driving Wakefield piling		500.00
Cutting off piles in foundation		500.00
Putting in timber foundation, 67,000 feet, at $10		670.00
148,488 feet B. M. lumber for forming, at $20		2,949.76
7,417 yards cement (National cement), at $2.74 per yard for material		20,322.58
1,325 yards cement (Portland cement), at $4.74 per yard for material		6,280.50
Erecting and removing forms, at 75 cents per yard		6,554.25
Labor, mixing and depositing concrete, at $1.50 per yard		13,108.50
Superintendence		5,000.00
		62,385.59
Credit by material on hand:		
Cement	$3,509.62	
Sand	3,009.53	
Gravel	4,970.00	
		11,489.15
		50,896.44
Contingencies, 10 per cent		5,089.64
Total		55,986.08

April 2, 1897.

Fixtures, appurtenances, and miscellaneous expenditures pertaining to lock and grounds.

Lock gates and maneuvering apparatus for same	$7,500.00
Quoin casings and heel posts	427.00
Filling valves and maneuvering gear	470.00
Screen	160.00
Miter sills, framing and placing	150.00
Guide pier above lock	690.00
Riprapping slope adjacent to lock walls	1,080.00
Purchase of additional ground, moving lock-keeper's house, building warehouse, surfacing and grading grounds, fencing, and similar expenses	5,000.00
Superintendence	2,000.00
	17,477.00
Ten per cent for contingencies and general expenses	1,747.70
Total	19,224.70

April 8, 1897.

be realized in practice. If the circular arc DP were entirely flexible, it would assume a curved form (a modification of the hydrostatic arch), and would transmit stresses to its extremities in directions tangent to the curve at those points. If, on the other hand, it were a rigid beam, it would transmit those stresses in directions perpendicular to the line of the resultant of the pressure on the arc DP.

It is evident that this last assumption must be the severest possible on the frame LMNO, and it is accordingly adopted, although it could never be perfectly realized in practice. The total pressure, and its point of application and direction, are shown on the diagram. Deducing the strains in DP, LO, and MN by the method of moments, and assuming DP and LO to be replaced by a single member midway between them, gives

$$\text{Strain in medial line} = \frac{52 \times 3.7}{6} = 32.1 = 10{,}020 \text{ pounds.}$$

Dividing this by 2, gives 5,010 pounds in each of the members DP and LN.

$$\text{Strain in MN} = \frac{52 \times 8}{6.45} = 64.4 = 20{,}025 \text{ pounds.}$$

STRAINS ON MEMBERS OF GATE.

The maximum load which any of the planks in the upper face can bear occurs when the upper pool stands at 117.5. The load on the lower plank is then 8.4 feet, and the pressure per square foot is 8.4×62.5=525 pounds.

The mean pressure per foot-length for the lower half of the member AC may be derived from an assumed 7-foot head, which is slightly greater than could occur in practice. This beam must support the pressure on a 5-foot length of gate surface. For a 7-foot head this amounts to 5×7×62.5=2,187.5 pounds.

The strain in CT may be deduced from the maximum load on AC (55.5) already determined. AC being a continuous beam on three equidistant points, the center point bears five-eighths of the load, or 34.7. This for a 5-foot length of gate amounts to 9,937 pounds.

The strains on the other members are too unimportant to require computation.

The maximum possible horizontal thrust on entire structure occurs when upper pool stands at 116 feet and lower pool at 100 feet. It amounts to 8,000 pounds per foot-length of dam, or 40,000 pounds for every 5 feet. This is resisted by 10 piles, making 4,000 pounds per pile.

OPERATION OF GATE.

The weight of the gate in air is 668 pounds per linear foot. The center of gravity is 4.8 feet from axis of revolution and 0.4 feet from medial line of sector.

Of the above weight 536 pounds is wood, assumed to have the same specific gravity as water, and 132 pounds is iron, assumed to lose one-seventh of its weight in water. The weight of the gate submerged is therefore 113 pounds per linear foot. Its center of gravity is on medial line of sector, 5.6 feet from axis.

When the gate starts to rise it is partly in air and partly in water. An estimate of its effective weight in this position is 388 pounds per linear foot, with a lever arm of about 4.5 feet.

	Foot-pounds.
Its moment about A is	1,746
Assume friction to be 15 pounds per linear foot of gate, with a lever arm of 8.6 feet, moment of friction is therefore	129
The moment of the water resting on upper surface of the gate is about	385
Total downward movement	2,260

The initial head when the gate begins to rise under ordinary conditions of the river is 2 feet. This head is evenly distributed over AB, with a mean lever arm of 4.3 feet. The moment about A is therefore

$$8.6 \times 2 \times 62.5 \times 4.3 = 4622$$

The excess of upward over downward moment is 2,362 foot-pounds per linear foot of the gate. This is equal to 550 pounds excess of upward pressure per linear foot of gate, or 41,520 pounds for the entire gate.

Owing to the influence of the Missouri River on the Osage in its lower course, it occasionally happens that a high stage of water occurs at the site of the lock when the discharge of the Osage is comparatively small. It may become desirable at such times to raise the gate when the water stands on a level above it and without current enough to create a velocity head worth considering. In such cases an auxiliary power would be required to raise the gate. Although this contingency could rarely arise, still it is thought best to provide for it, and this is done by conveying air from shore into the interior of the gate and forcing the water out until sufficient buoyance is obtained to lift the gate. To ascertain what portions of the surface of the gate must be made air-tight, the following computation has been made:

The weight of the gate in water is the weight of the iron it contains less about one-seventh for loss in water. This makes the effective weight 113 pounds per running foot. The center of gravity is on a medial line and is distant from A 5.6 feet. For the lowest, highest, and medium positions of gate, the lever arms about A are 4.72 feet, 5.55 feet, and 5.1 feet, respectively (see diagram, fig. 2). The corresponding moments about A of the entire gate (75 feet long) are—

$$
\begin{array}{r}
\text{Foot-pounds.} \\
75 \times 113 \times \left\{ \begin{array}{l} 4.72 = 40{,}002 \\ 5.55 = 47{,}036 \\ 5.1 \;\; = 43{,}222 \end{array} \right.
\end{array}
$$

Let each of these be multiplied by 3, in order to provide an ample surplus of lifting power. They then become—

120,006 foot-pounds for lowest position.
141,108 foot-pounds for middle position.
129,666 foot-pounds for highest position.

Discarding the weight of the air, and assuming that every cubic foot of space from which the water is forced gives a vertical upward lifting force of 62.5 pounds, the necessary spaces in the three positions can be readily determined by a few trials, or more laboriously by algebraic equations. The distances from the crest C′ to the water surface in the three cases are found to be

.82 foot for lowest position.
2.13 feet for middle position.
3.00 feet for highest position.

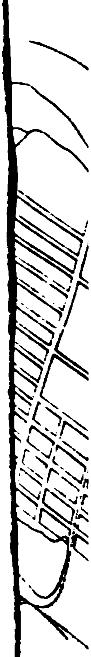
Plotting these water lines on a single figure, and drawing an approximate tangential curve to them, gives the line above which all surfaces should be made air-tight.

REPAIR OF GATE.

To accomplish this, let a bulkhead VWX be erected, supported as shown in the detailed plans, and assume the stage of the upper pool to be 1 foot above C. In practice, a much lower stage could probably be selected. Let the bulkhead be supported by struts XC and WS, resting against the upper surface of the gate, and let the gate be supported at the circumference on the frame LMNO. The pressure of the upper pool on the bulkhead and the weight of the gate are thus supported at A and B. The stresses on the upper and middle struts are 675 pounds and 6,600 pounds, respectively, and the sum of the components acting along AC is nearly 5,000 pounds (extension). The other components carried to B and resolved into new components acting vertically, and along AB, give for the sum of vertical components 4,150 pounds, and for the sum of those acting along AB nearly 5,000 pounds (extension). The resultant of the two forces in AB and AC lies midway between them and amounts to 8,400 pounds.

The weight of the gate, as already stated, is 668. A projection of its center of gravity in highest position upon a horizontal line through A is 4.4 feet distant from A. The weight is therefore almost equally divided between A and B, and the former point must support 333 pounds. Combining this with the above strain of 8,400 pounds would but slightly alter the latter, either in amount or direction.

HIRAM M. CHITTENDEN,
Captain of Engineers.



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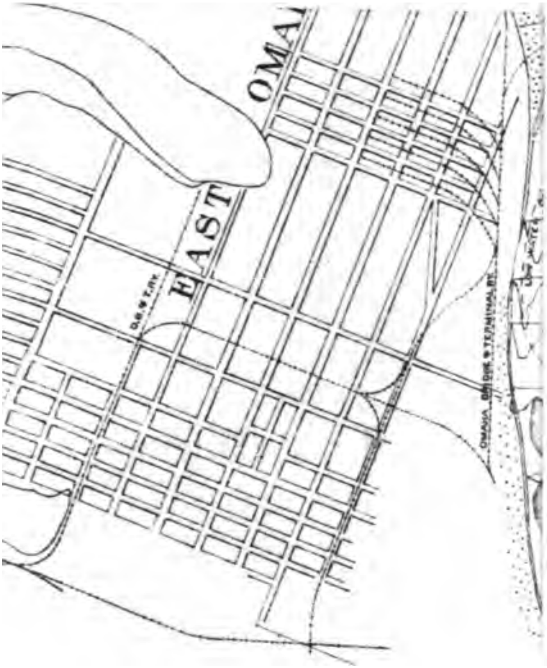

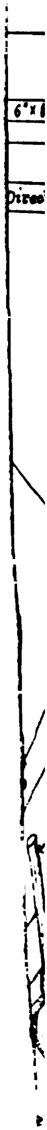

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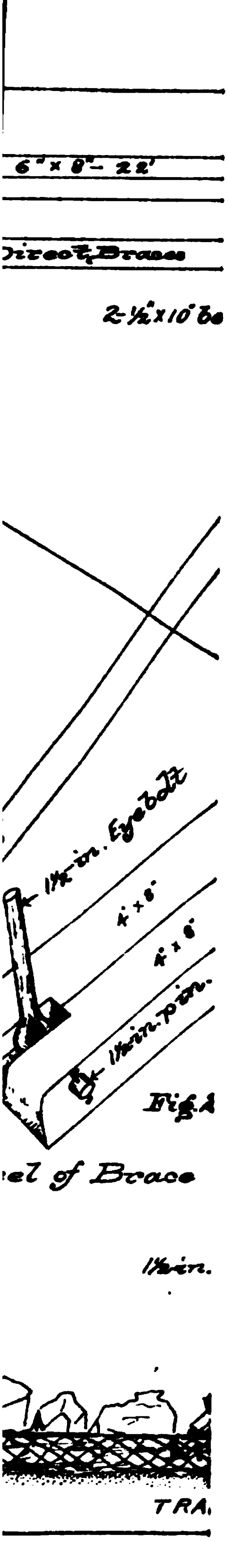
6" × 8" – 22'
irect Braces
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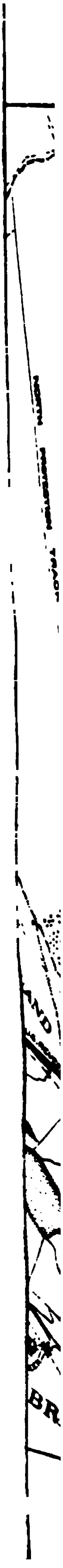
Fig. A
el of Brace
1¼ in.
TRA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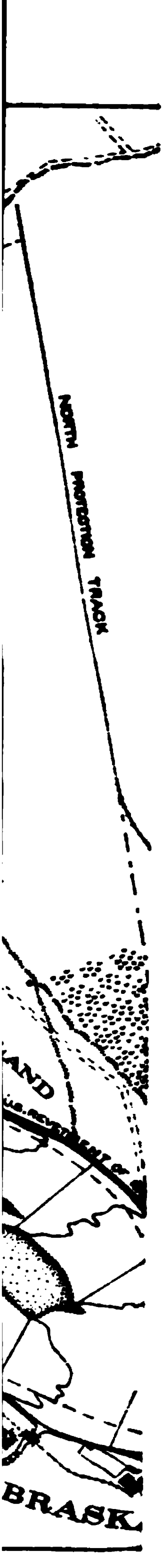
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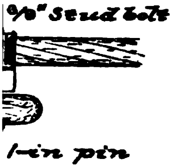

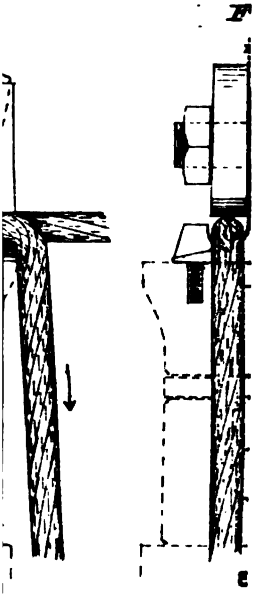

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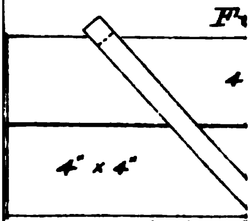
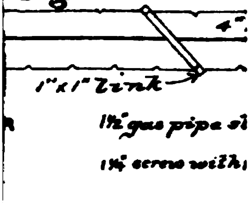


DETAILS OF

Fig 12



JRI RIVER COMMISSION,

DIVISION, FIRST REACH.

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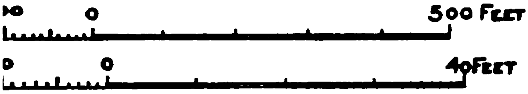
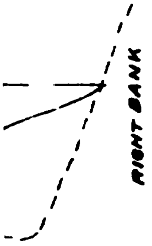
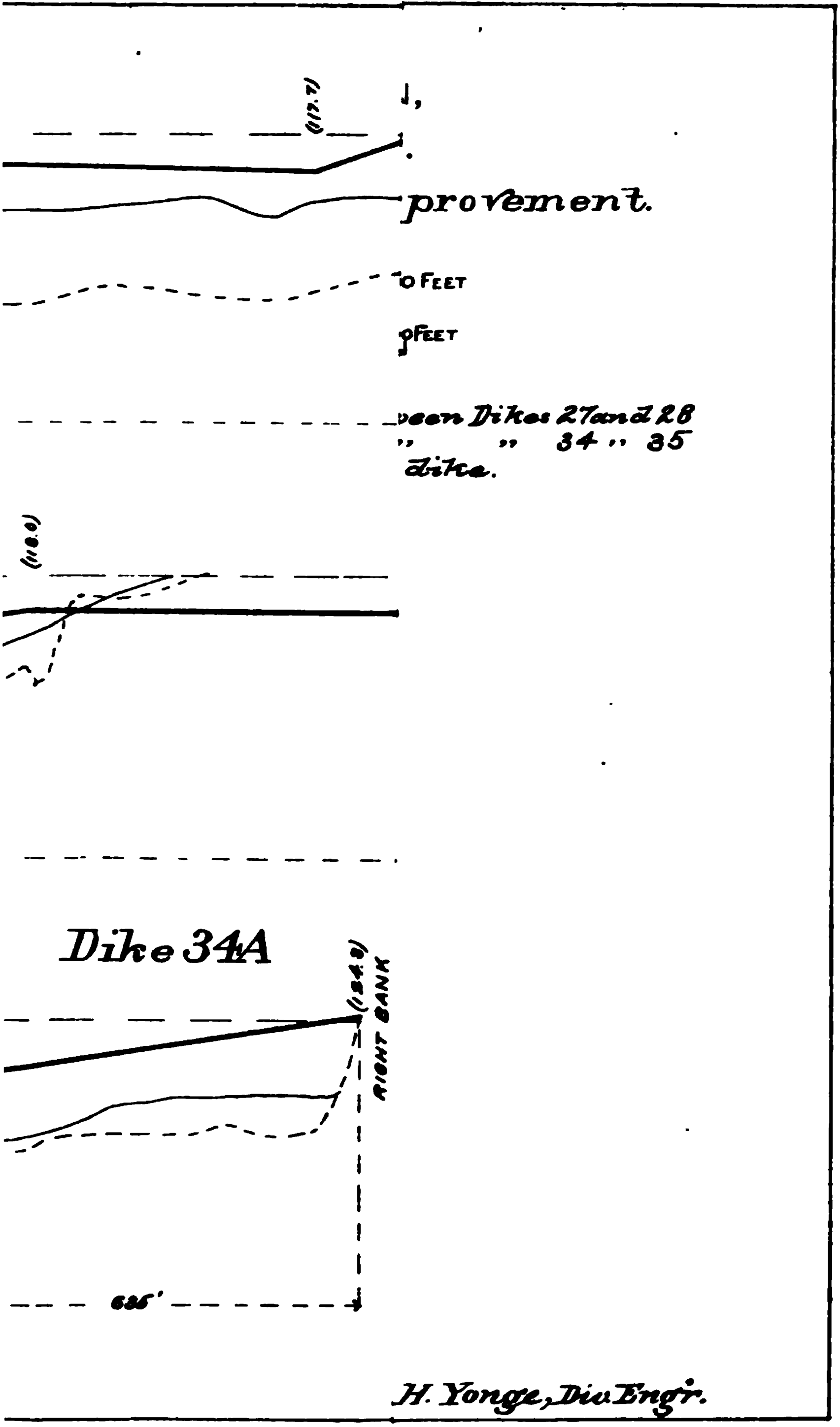


10, sounded Aug. 5, 1891, on line of dike.
" " " *19, 1896, half way between Dikes 10 and 11*
13A " " *6, 1891, on line of Dike 13*
" " " *19, 1896, half way between Dikes 13A and 13B*
18 " " *7, 1891, on line of Dike 17.*
" " " *26, 1896, half way between Dikes 18 and 19.*



al report for 1897 of Sam'l H Yonge, Div. Engin

PLATE III.



H. Yonge, Div Engr.

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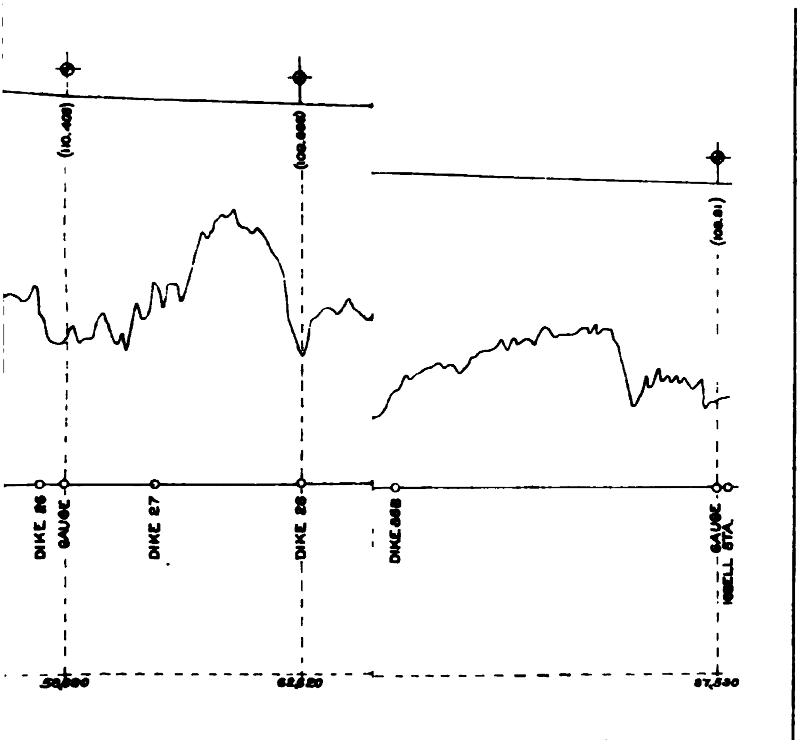

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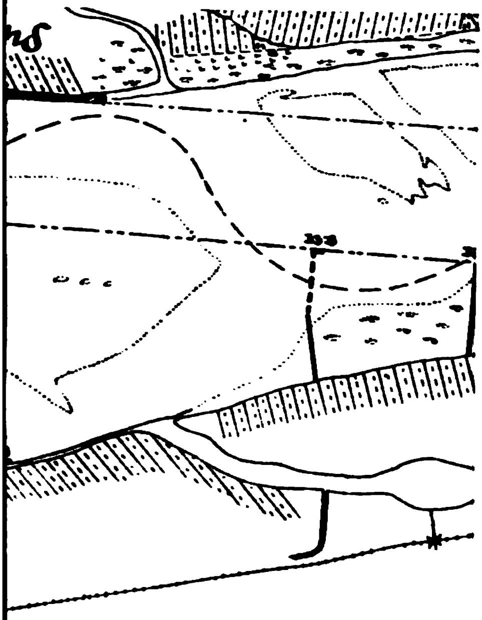

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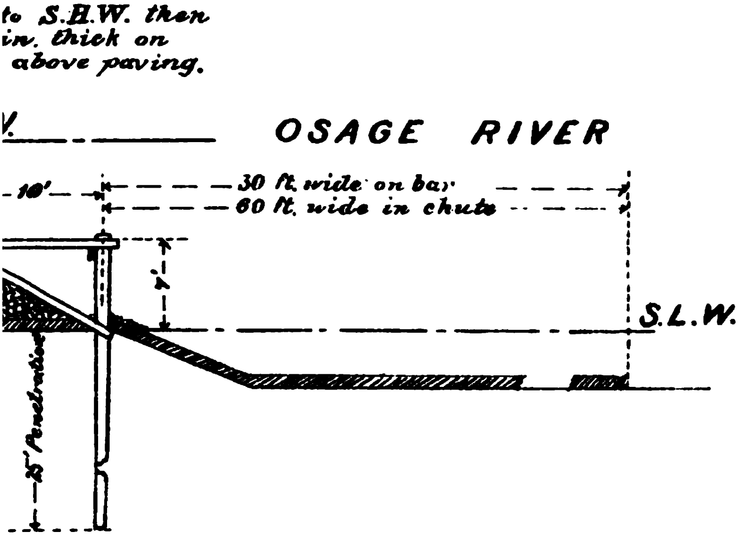
PLATE III



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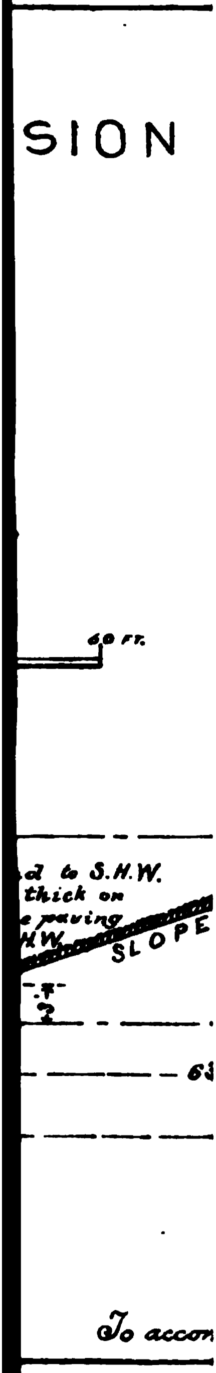
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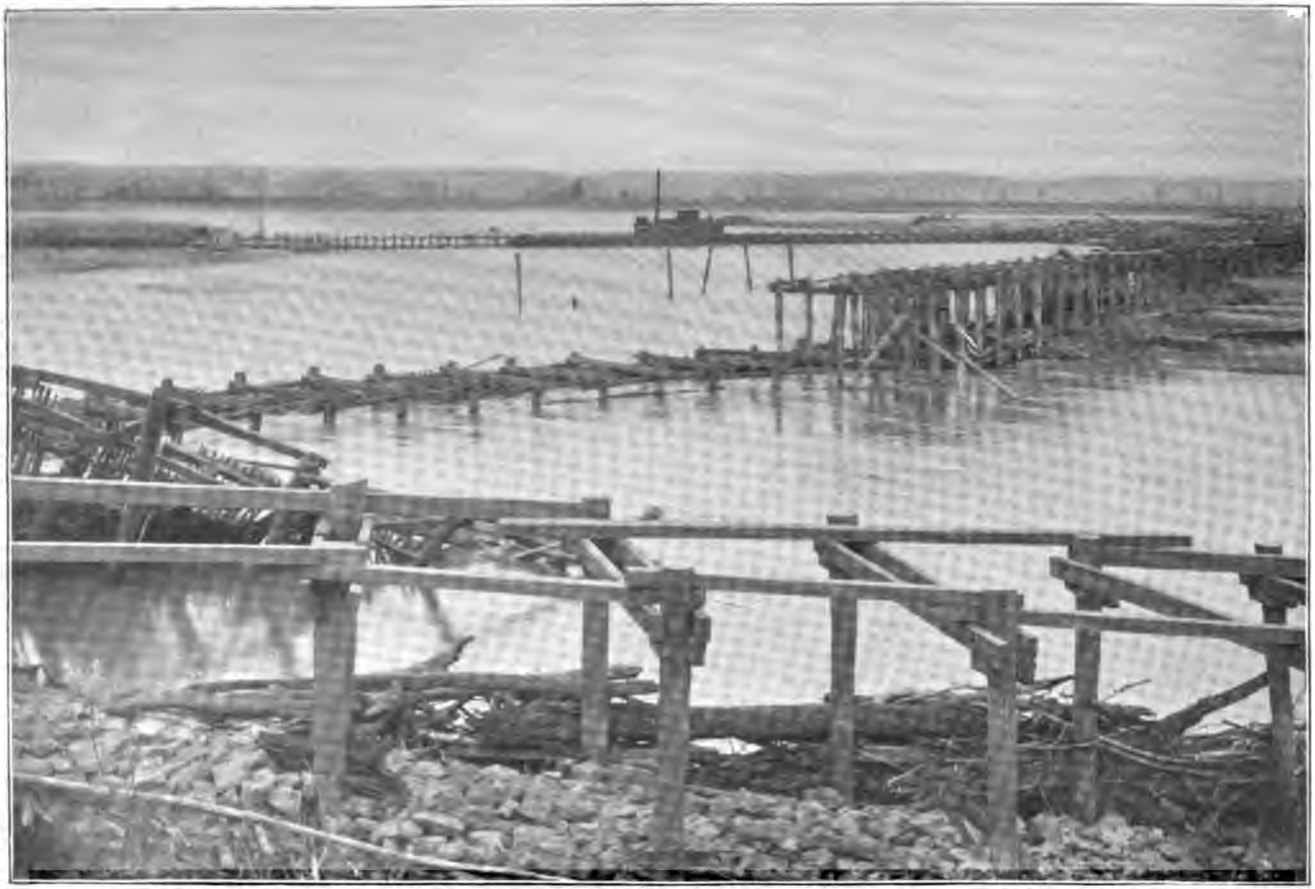

SHOWING DIKE 19½ A IN PROCESS OF CONSTRUCTION IN THE DISTANCE; LOW DIKE, CLOSING BREACH AT SHORE END OF 19 B, COMPLETED, IN MIDDLE GROUND; OLD TWO-ROW WORK ON TOP OF SHORE END OF OSAGE DAM IN FOREGROUND. VIEW TAKEN NOVEMBER 17, 1896, FROM OSAGE POINT LOOKING NORTHWARD UP OSAGE DAM CHUTE.

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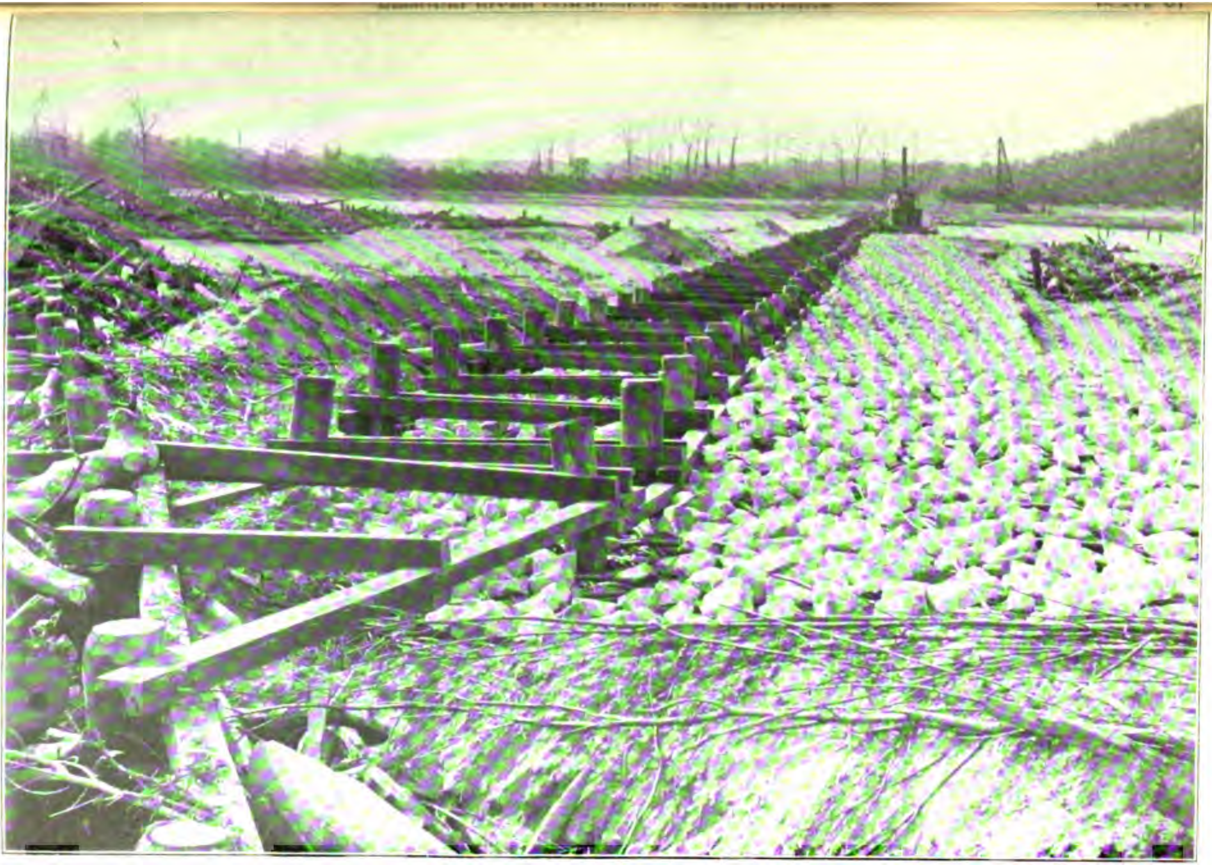

SHOWING DIKE 19½ A IN PROCESS OF CONSTRUCTION. VIEW TAKEN NOVEMBER 17, 1896, FROM A POINT NEAR JUNCTION WITH 19 B. LOOKING WEST.

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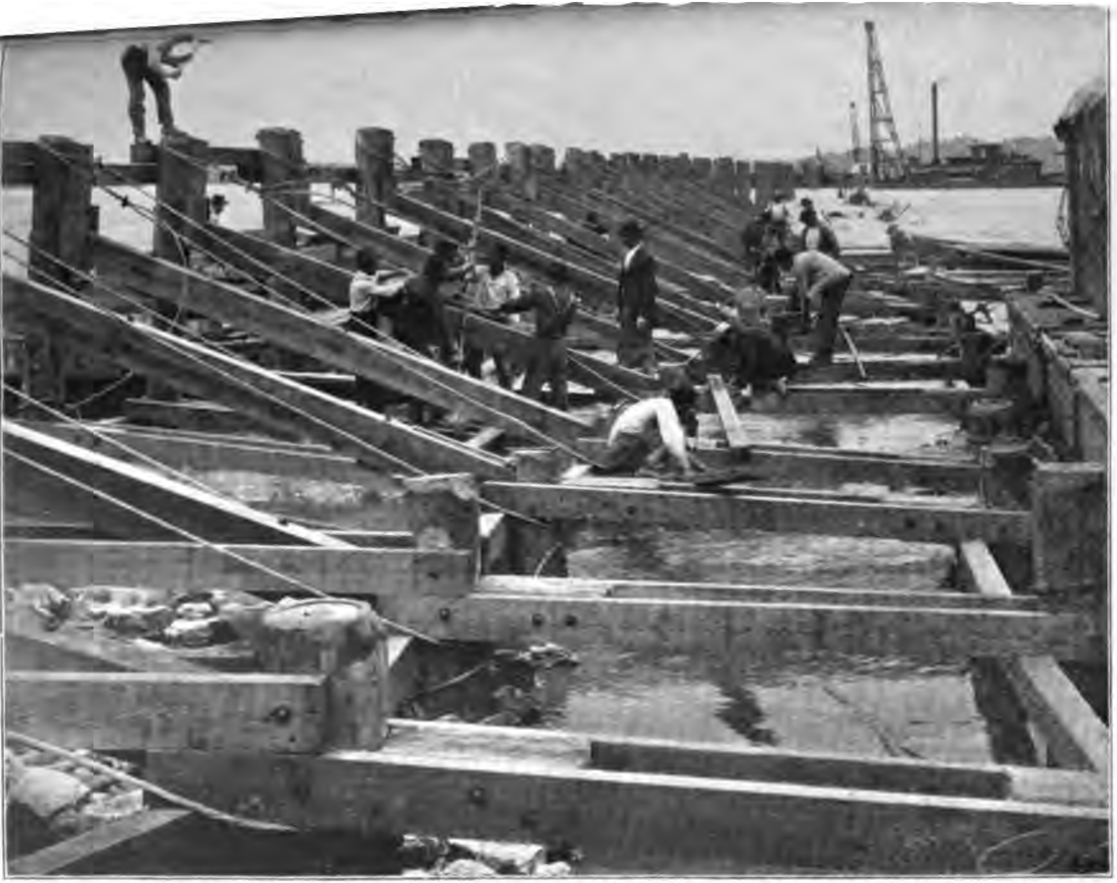
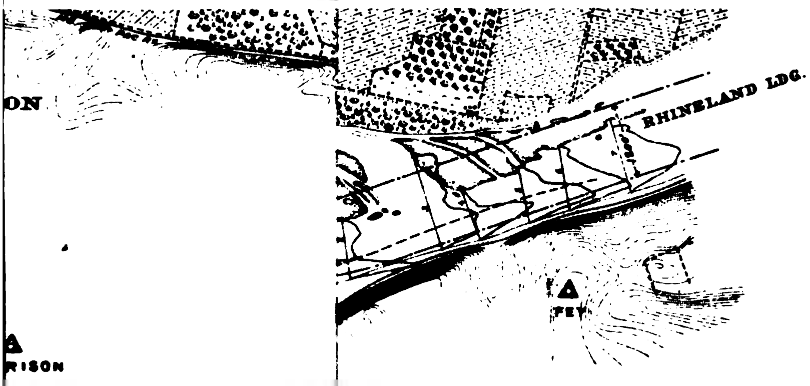


SHOWING CONSTRUCTION PARTIES AT WORK ON REPAIRS, EXTENSION, AND REINFORCEMENT OF DIKE 19½ A; BRACING PARTY IN FOREGROUND ON WEST EXTENSION ACROSS NEW WATERWAY. VIEW TAKEN JUNE 3, 1897, FROM POINT OF SHORE BAR IN LINE OF DIKE NEAR JUNCTION WITH DIKE 19 A. LOOKING EAST.

16



7 . of S. Waters Fox . Div'n. Eng'r.

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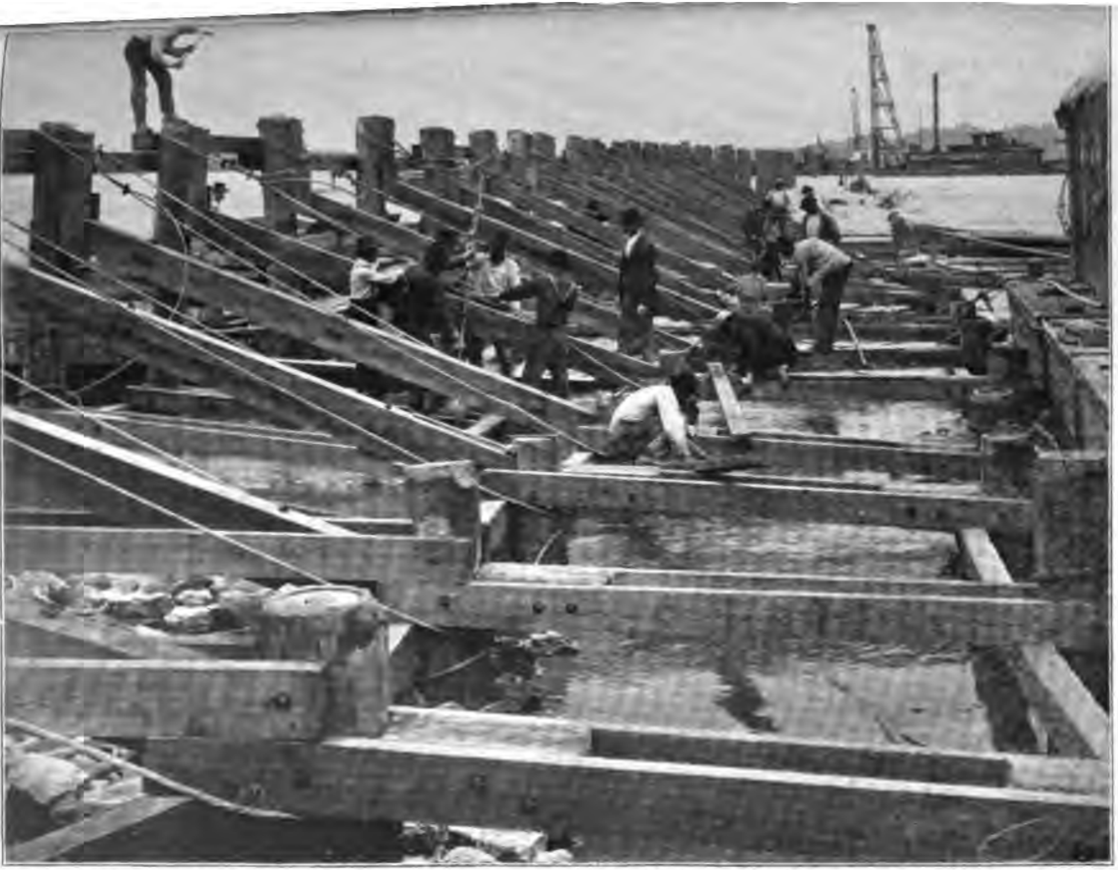

SHOWING CONSTRUCTION PARTIES AT WORK ON REPAIRS, EXTENSION, AND REINFORCEMENT OF DIKE 19½ A; BRACING PARTY IN FOREGROUND ON WEST EXTENSION ACROSS NEW WATERWAY. VIEW TAKEN JUNE 3, 1897, FROM POINT OF SHORE BAR IN LINE OF DIKE NEAR JUNCTION WITH DIKE 19 A. LOOKING EAST.

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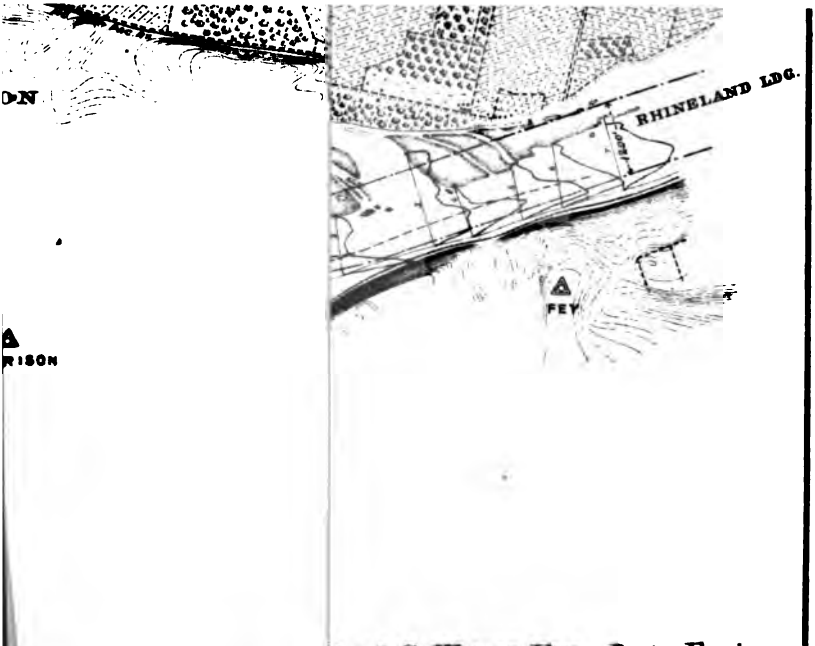

7. of S. Waters Fox. Div'n. Engr.

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Reference

ec. 1895	Stage	2.5	Ft.	below	S. L. W.
1896	"	7.2	"	above	" " "
ov. 1896	"	1.0	"	"	" " "
1897	"	5.0	"	"	" " "

To accompany annual report for 1897, of S Waters Fox, Div'n Eng'r.

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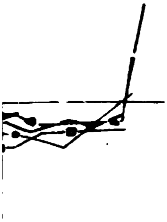
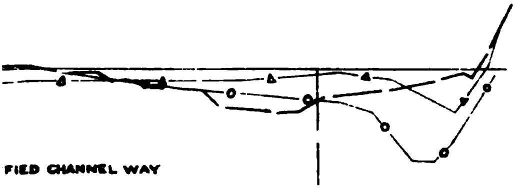
Vertical Scale 10 Ft. 0 10 20 30 40 Ft.

Reference

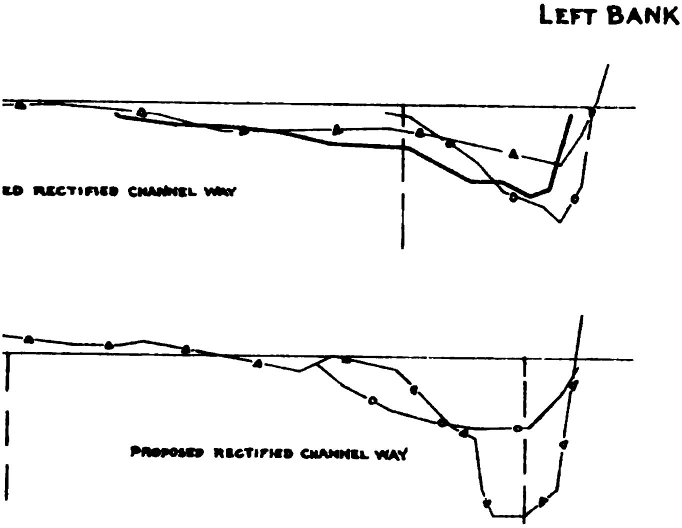
. & Dec.	1895	Stage	2.5	Ft.	below	S.	L.	W.
il	1896	"	3.0	"	above	"	"	"
e	1896	"	7.2	"	"	"	"	"
& Nov.	1896	"	1.0	"	below	"	"	"
e	1897	"	5.0	"	above	"	"	"





To accompany annual report for 1897, of S. Waters Fox, Div'n Engr.

Plate IV



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Gasconade Division
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Vertical Scale

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ril	1896	"	3.0	"	above	"	"	"
ne	1896	"	7.2	"	"	"	"	"
v. & Dec.	1894	"	2.0	"	below	"	"	"

To accompany annual report for 1897, of S Waters Fox, Div'n. Eng'r

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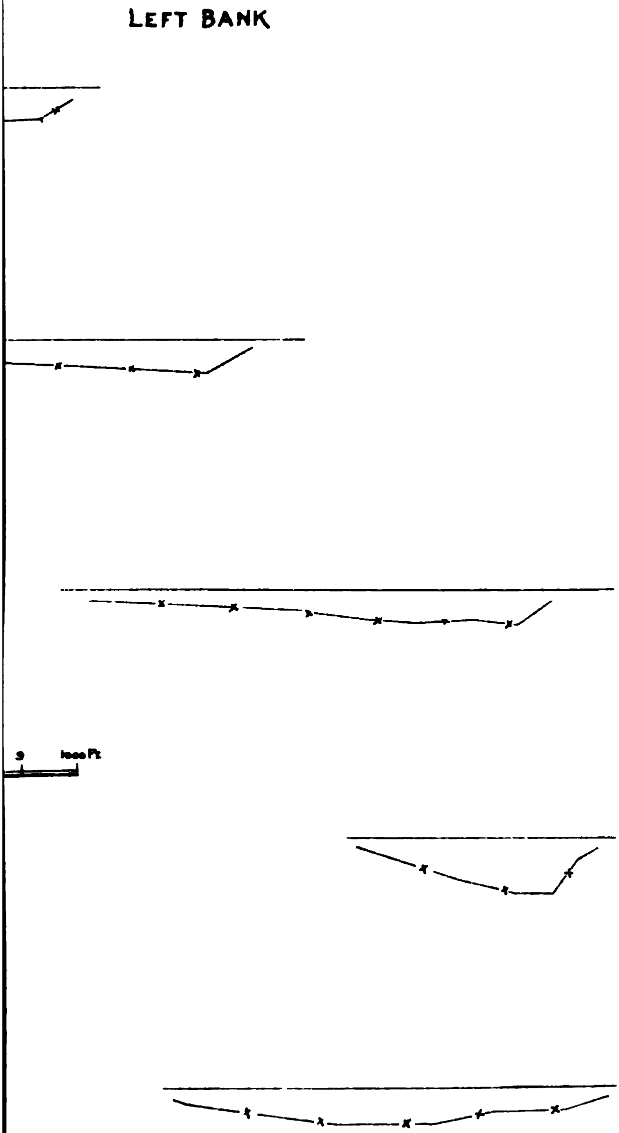
Plate V



To accompany annual report for 1897, of S. Waters Fox, Div'n. Engr.

Plate VI

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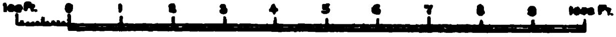

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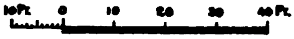

Reference

Dec. 1894 Stage 2.0 ft. below S. L.W.
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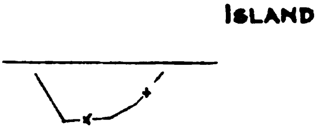

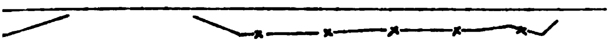

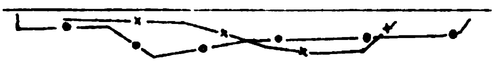

To accompany annual report for 1897, of S. Waters Asst. Div'n. Engr.

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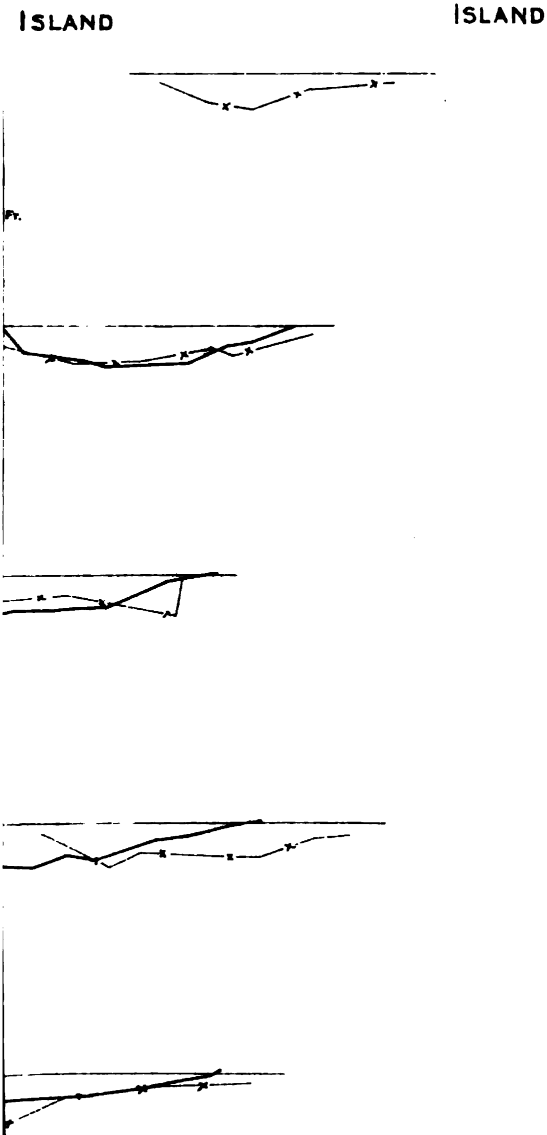

To accompany annual report for 1897, of S. Waters Fox, Div'n Engr

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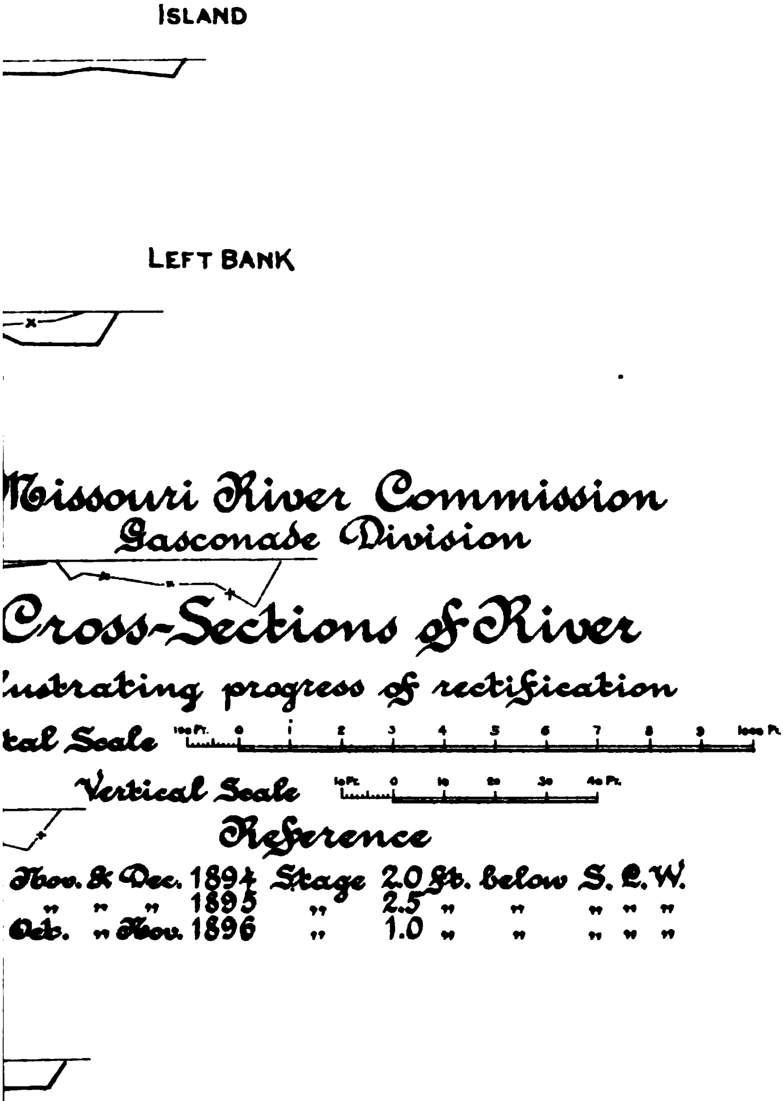

Missouri River Commission
Gasconade Division

Cross-Sections of River
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tal Scale 100 Ft. 0 1 2 3 4 5 6 7 8 9 1000 Ft.

Vertical Scale 10 Ft. 0 10 20 30 40 Ft.

Reference

Nov. & Dec. 1894 Stage 2.0 ft. below S. L. W.
" " " 1895 " 2.5 " " " " "
Oct. " Nov. 1896 " 1.0 " " " " "

To accompany annual report for 1897, of S. Waters Fox, Div'n. Engr.

Plate IX 26

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Gasconade Division
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Scale 100 Ft. 0 1 2 3 4 5 6 7 8 9 1000 Ft.

Vertical Scale 10 Ft. 0 10 20 30 40 Ft.

Reference

k Dec. 1894 Stage 2.0 ft. below S.L.W.
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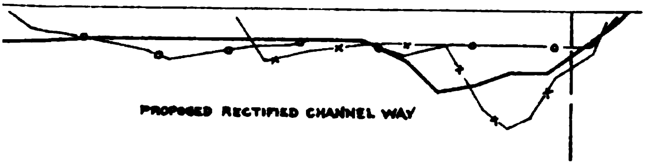

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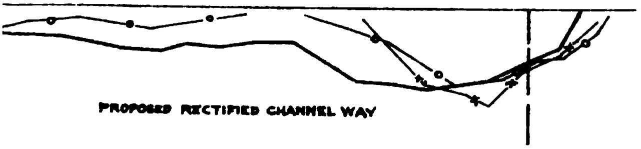

To accompany annual report for 1897, of S. Waters Jr., Div'n. Engr.

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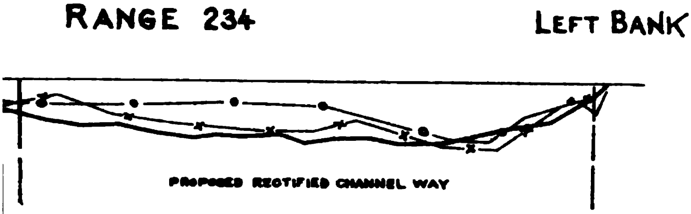

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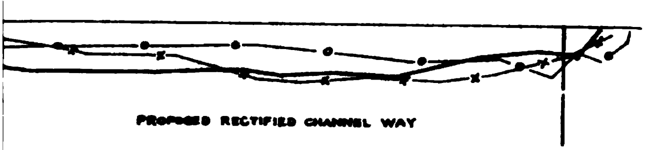

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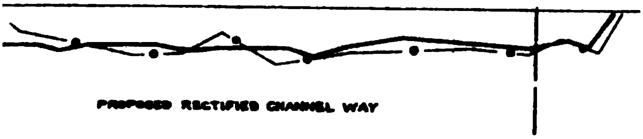

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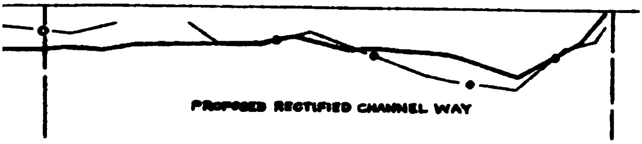

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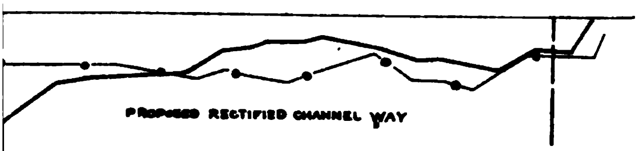

To accompany annual report for 1897, of L. Waters Fox, Div'n. Eng'r.

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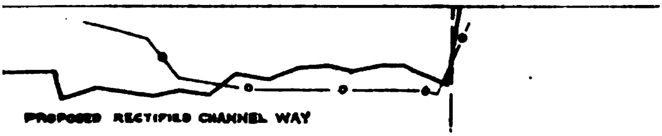

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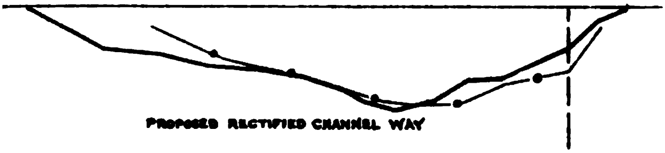

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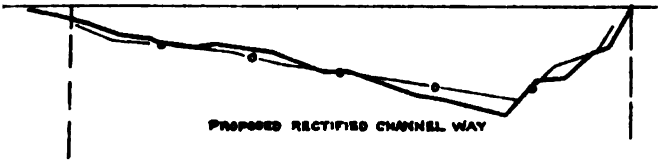

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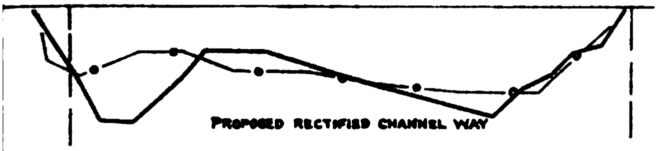

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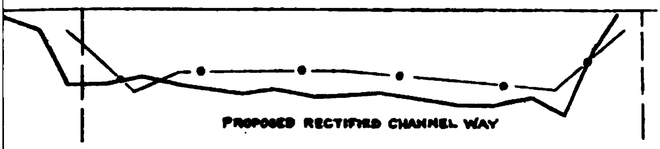

To accompany annual report for 1897, of L. Walters Asst., Divn. Engr.

Plate XIII

RANGE 224

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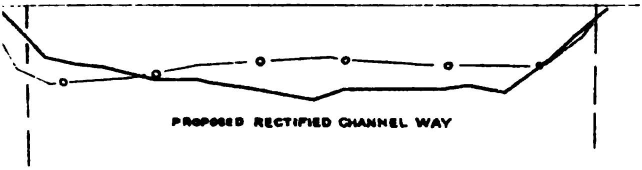

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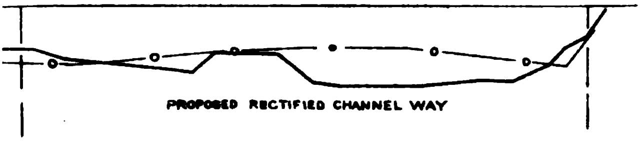

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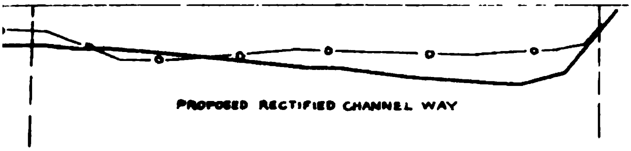

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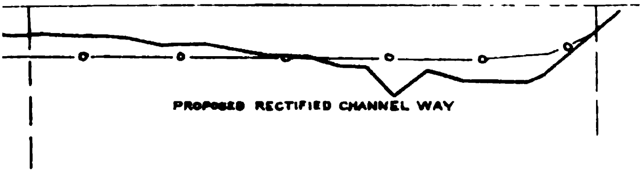

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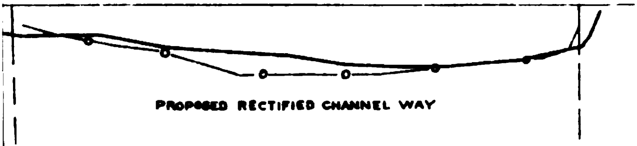

To accompany annual report for 1897 of L. Waters Fox, Div'n. Eng'r.

Plate XIV

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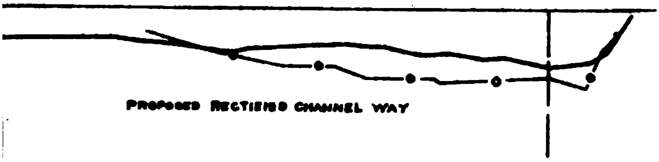

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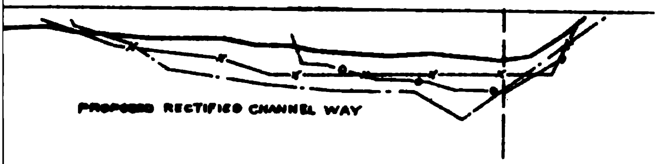

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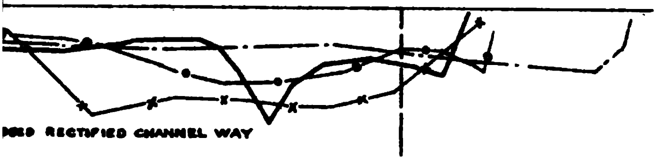

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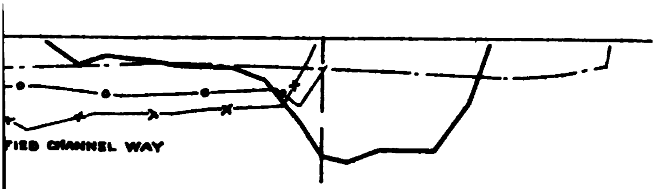
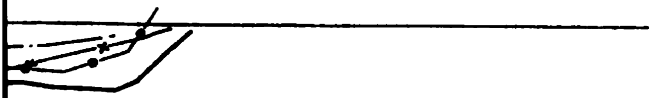


NGE 215



To accompany annual report for 1897, of S. Waters Tex., Div'n. Engr.

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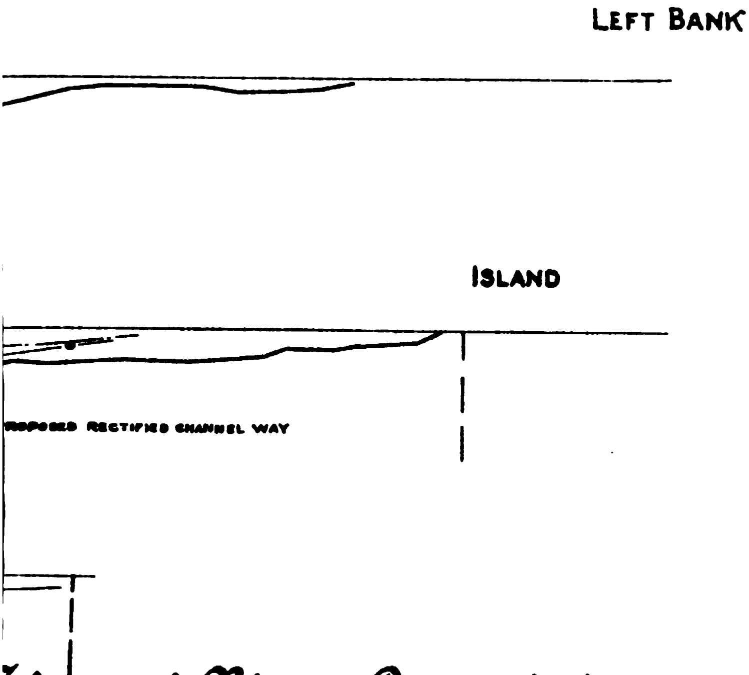
Plate XV



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Gasconade Division
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al Scale 100 Ft. 0 1 2 3 4 5 6 7 8 9 1000 Ft.

Vertical Scale 10 Ft. 0 10 20 30 40 Ft.

Reference

Nov.	1893	Stage	1.8	ft.	below	S.	L.	W.
" & Dec.	1894	"	2.0	"	"	"	"	"
" " "	1895	"	2.5	"	"	"	"	"
Oct. " Nov.	1896	"	1.0	"	"	"	"	"

To accompany annual report for 1897, of S. Waters Sec. Divn. Engr.

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souri River Commission

Gasconade Division

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Vertical Scale

Reference

1893 Stage 1.8 Ft. below S. L. W.
& Dec. 1894 " 2.0 " " " " "
" " 1895 " 2.5 " " " " "
" Nov. 1896 " 1.0 " " " " "

To accompany annual report for 1897 of S Waters Fox, Div'n. Engr.

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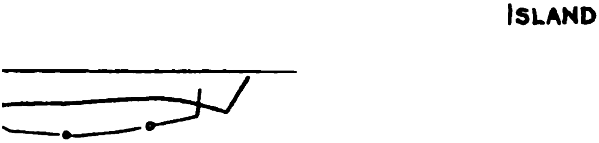

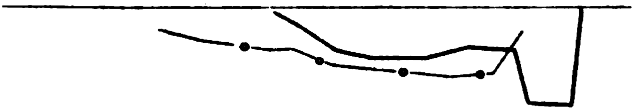

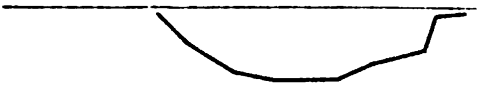

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Reference

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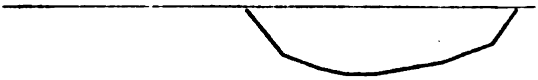

To accompany annual report for 1897, of J. Walters Fox, Div'n. Engr.

River Commission

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progress of rectification

0 1 2 3 4 5 6 7 8 9 1000 Ft.

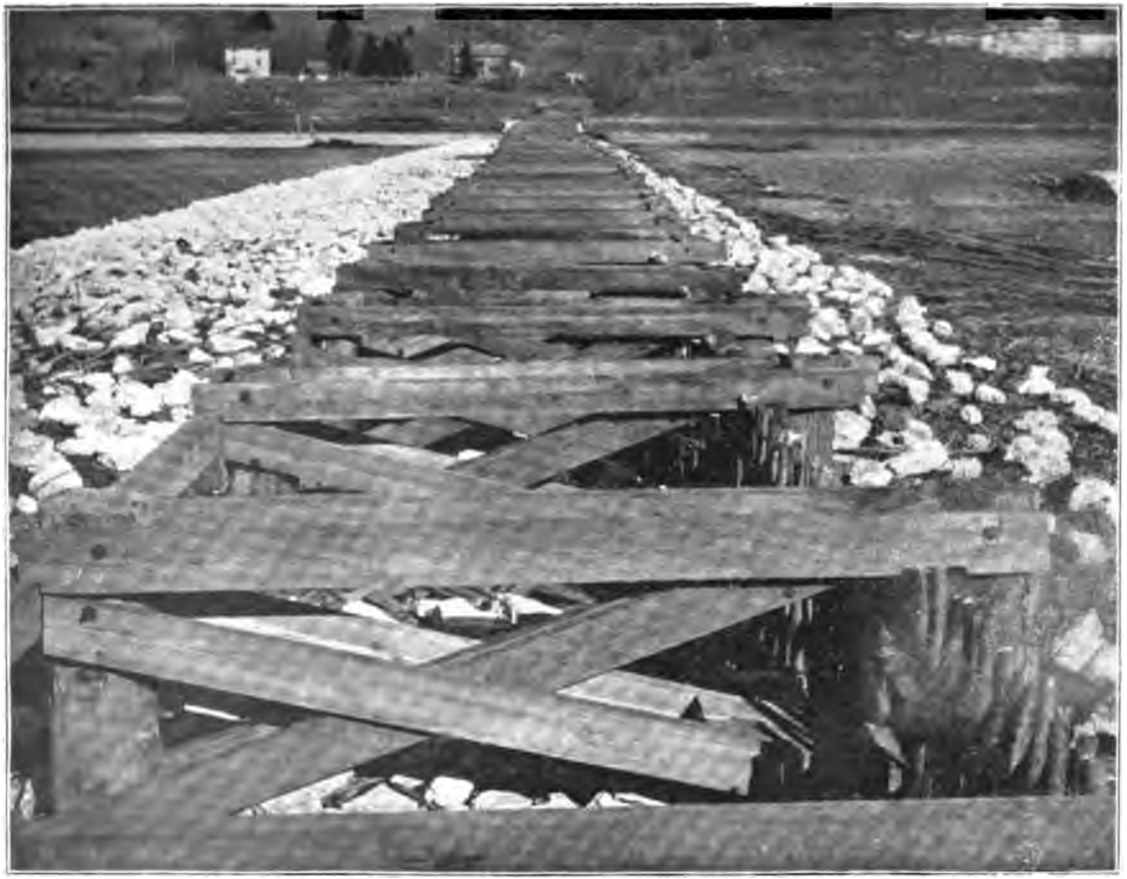
Scale 10 Ft. 0 10 20 30 40 Ft.

Reference

92 Stage 0.3 Ft. below S.L.W.
95 " 2.5 " " " " "
96 " 1.0 " " " " "

To accompany annual report for 1897, of S. Waters Fox, Div'n. Engr.

MISSOURI RIVER COMMISSION, GASCONADE DIVISION. PLATE XIX.



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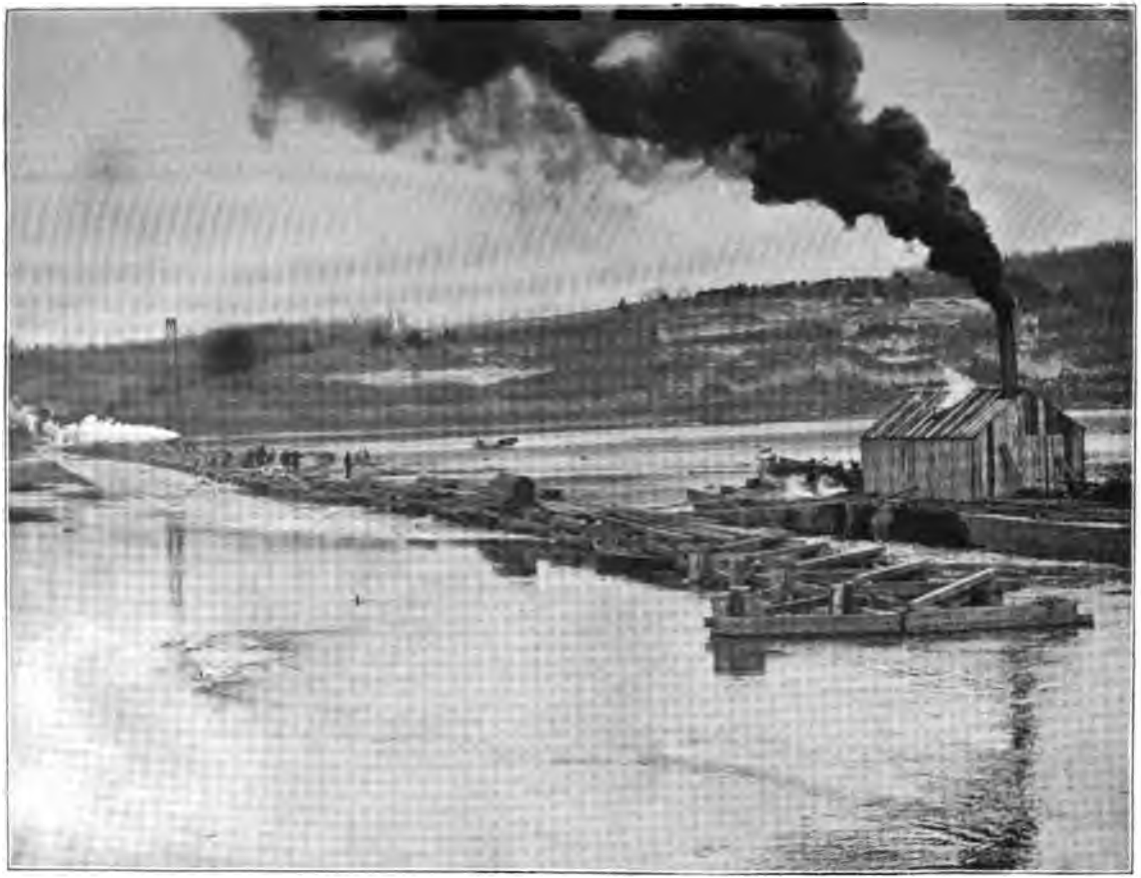
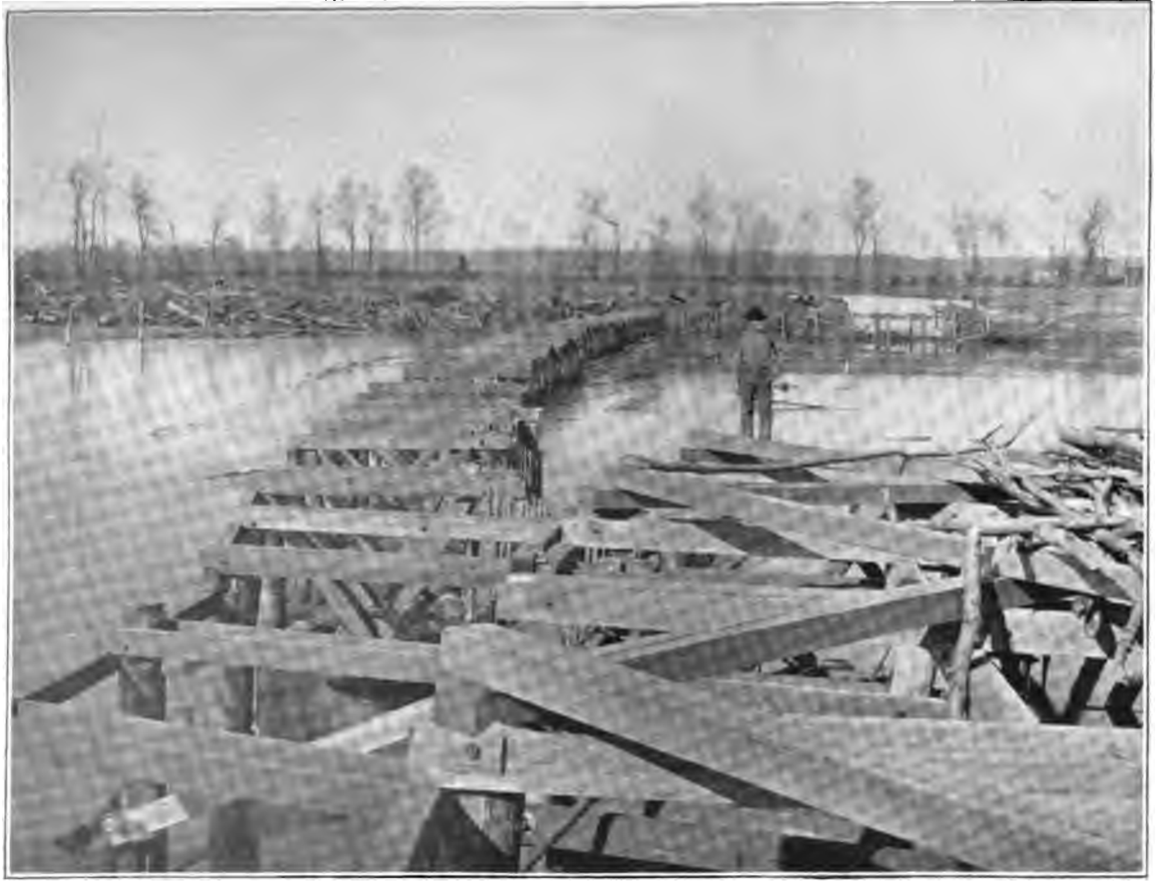
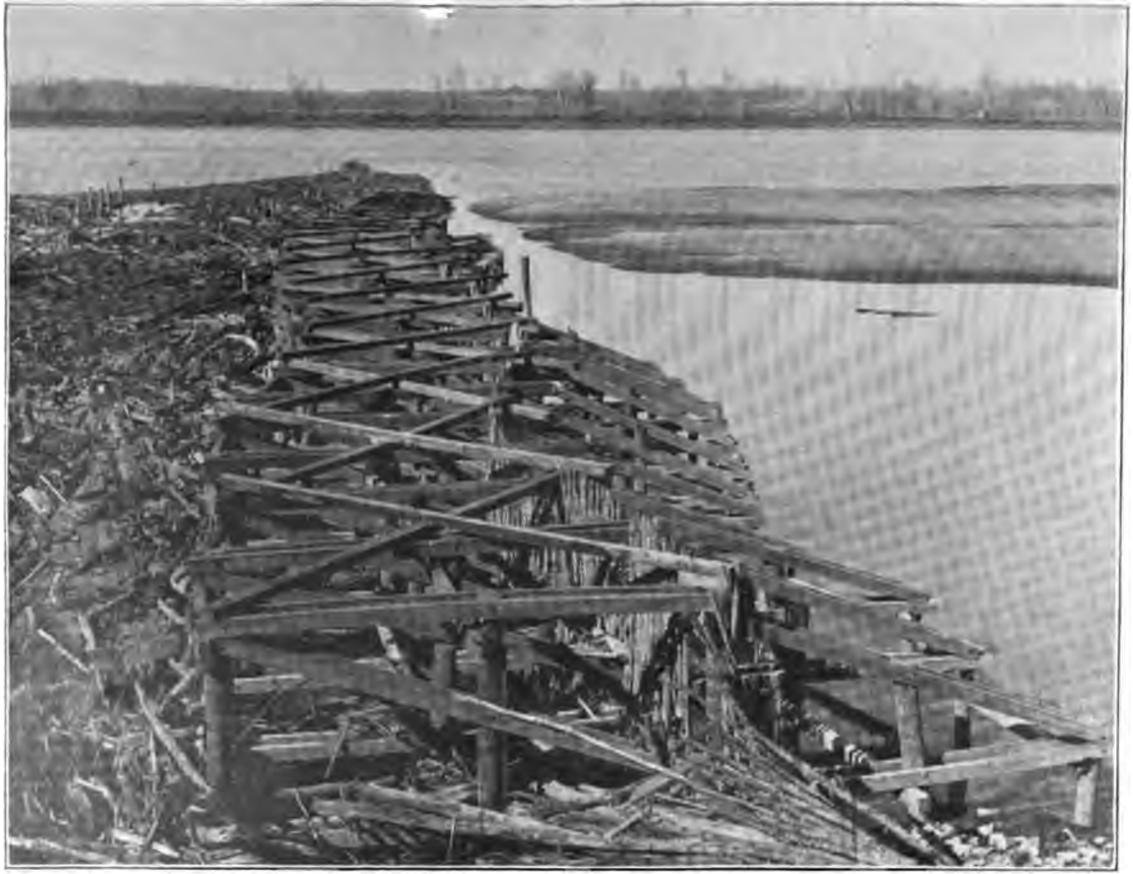


SHOWING DIKE XV IN PROCESS OF CONSTRUCTION. VIEW TAKEN DECEMBER 2, 1896. LOOKING INSHORE AND DOWNSTREAM.

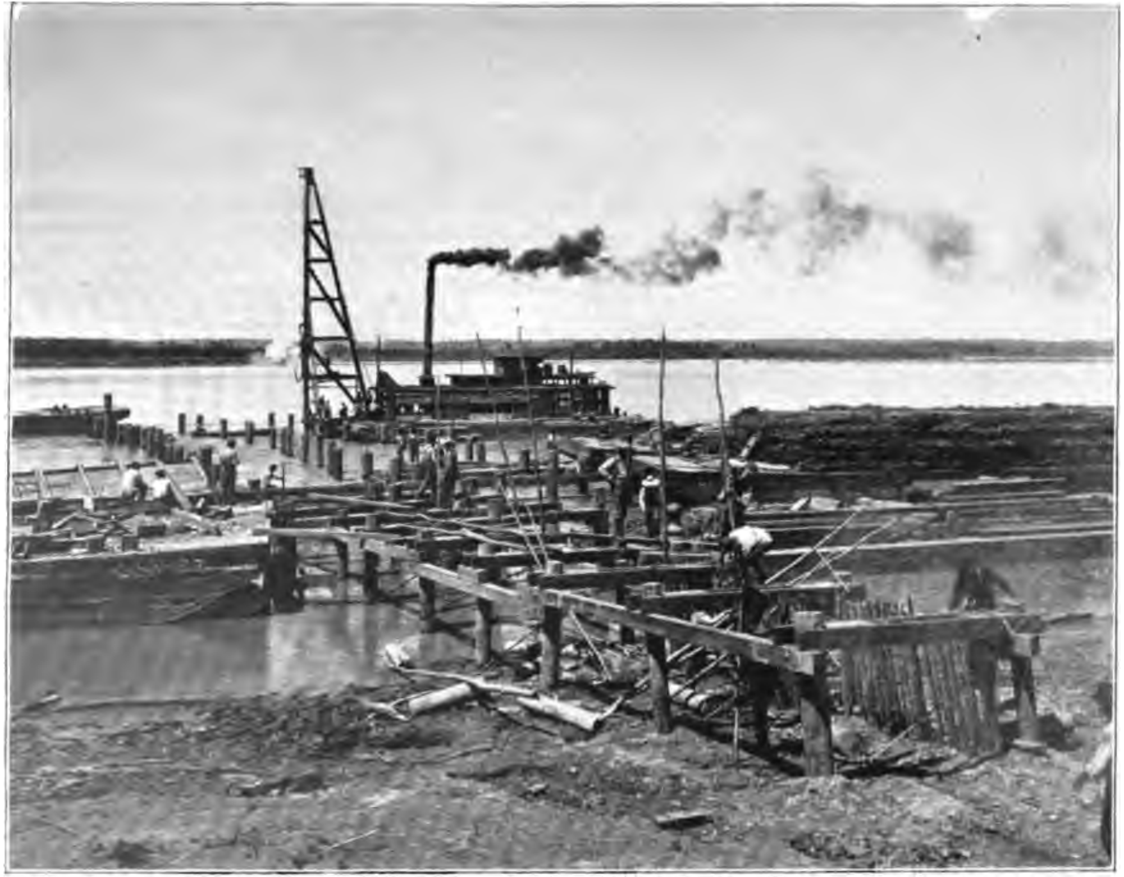
MISSOURI RIVER COMMISSION, GASCONADE DIVISION. PLATE XXI.



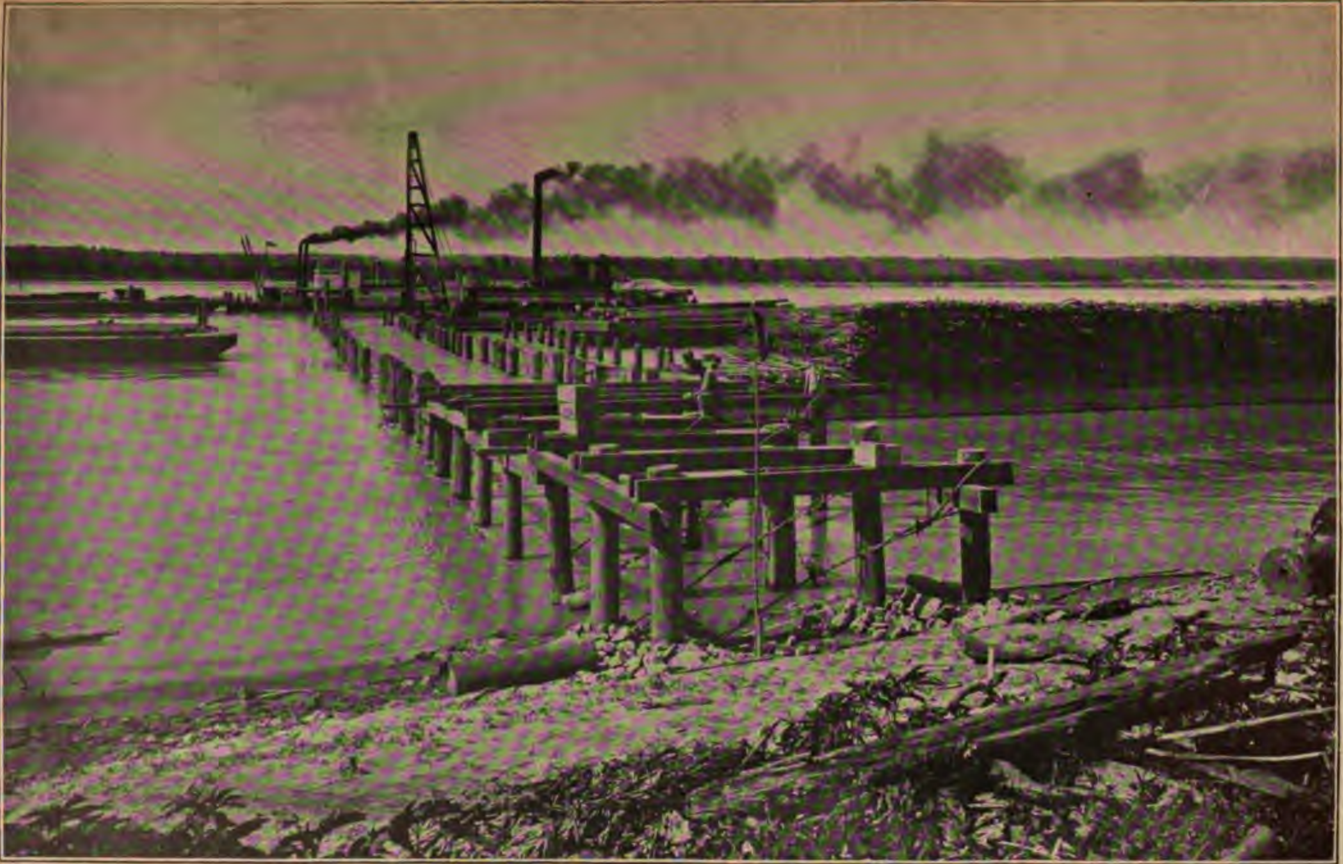
SHOWING DIKE XX A AS REPAIRED NEAR SHORE END IN FALL OF 1896. VIEW TAKEN DECEMBER 6, FROM A POINT ON OLDER STRUCTURE LOOKING INSHORE.



SHOWING DIKE I B. RESTORED. VIEW TAKEN JANUARY 18, 1897, FROM SHORE END OF DIKE.



SHOWING CONSTRUCTION PARTIES AT WORK ON DIKE XI A. VIEW TAKEN JUNE 18, 1897.



SHOWING CONSTRUCTION PARTIES AT WORK ON DIKE XI B. VIEW TAKEN JUNE 18, 1897.

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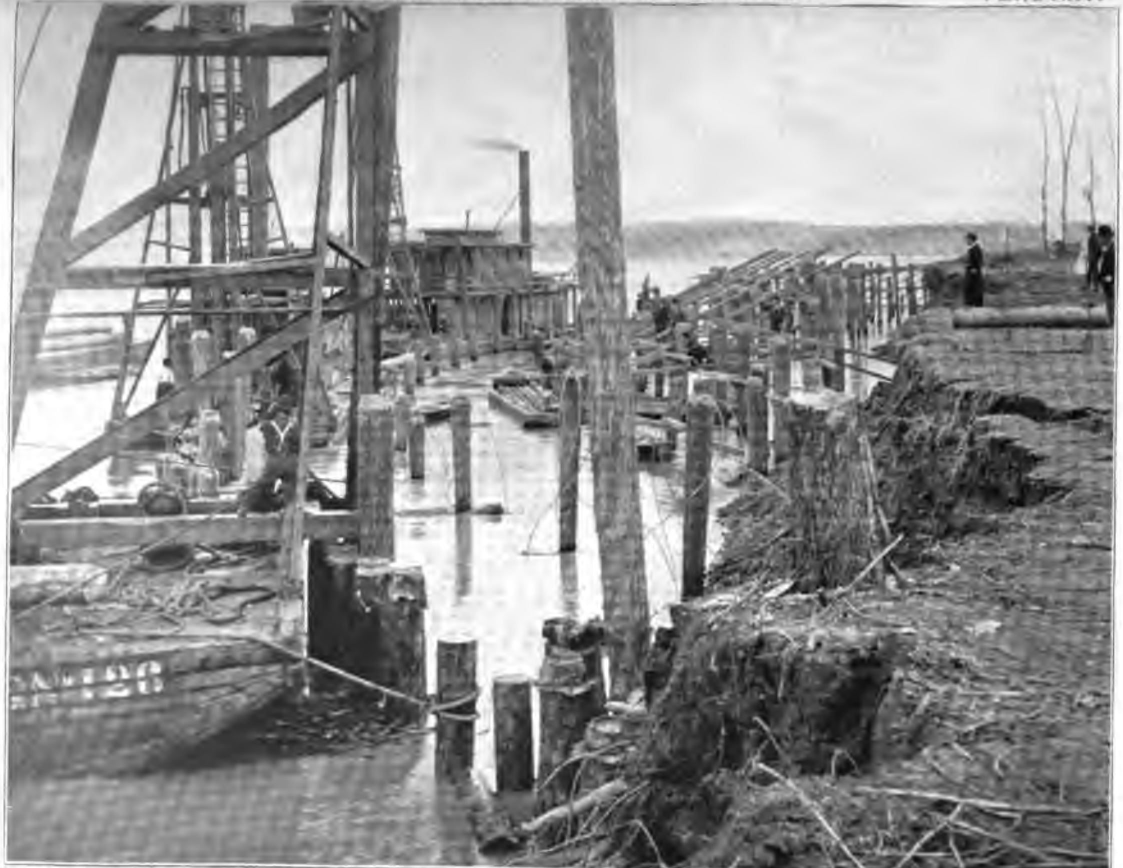
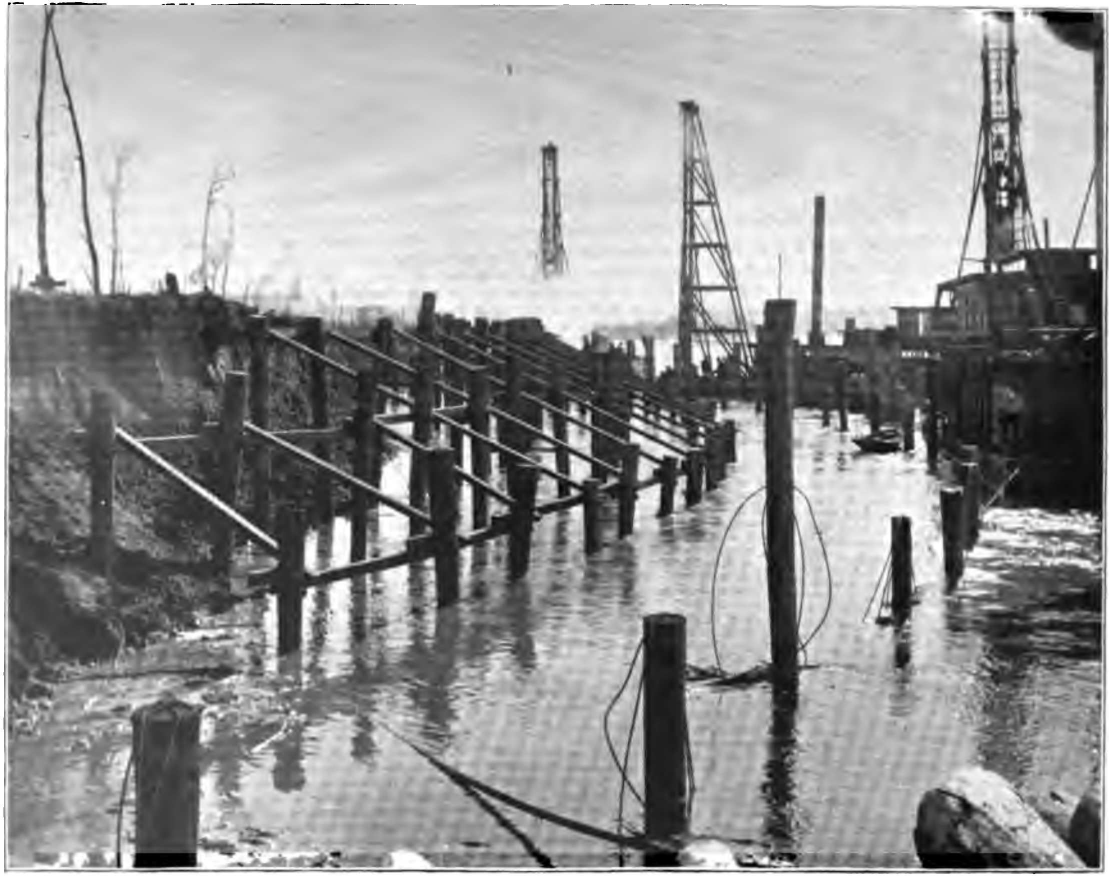
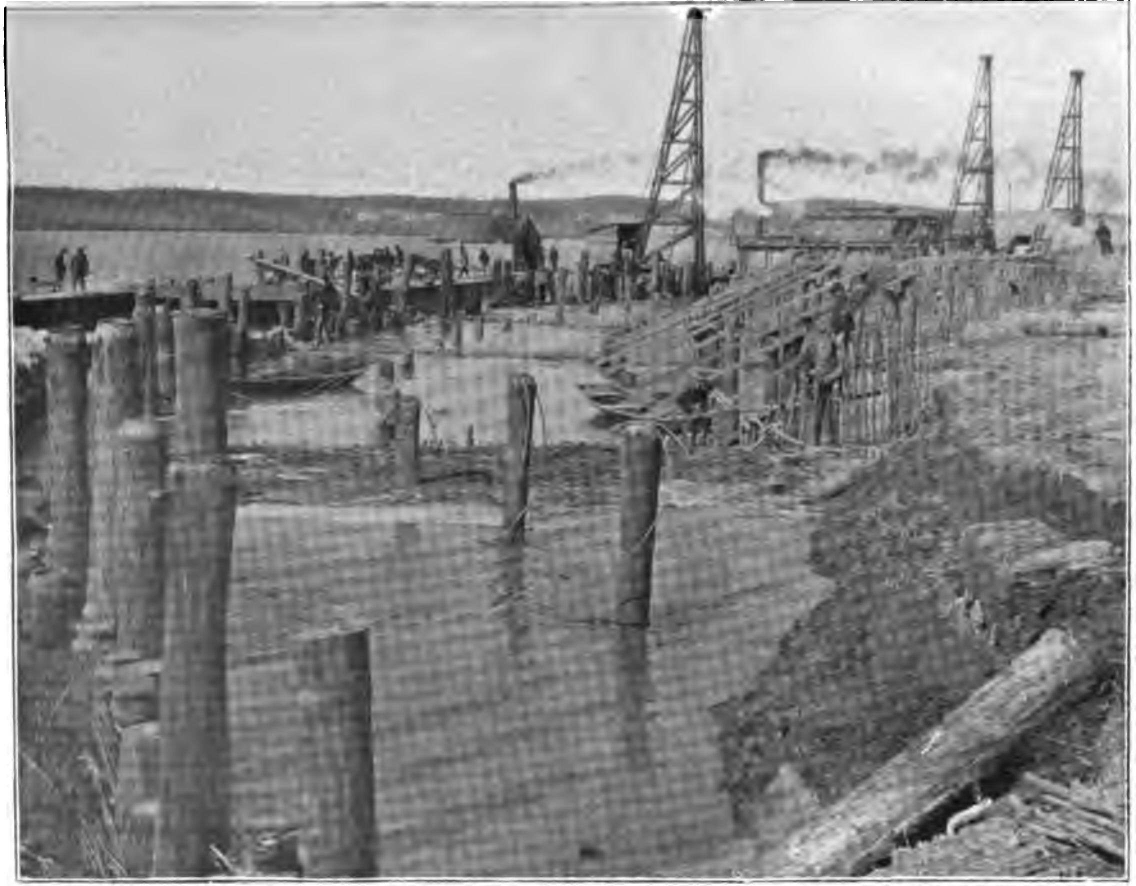


BANK HEAD, CHAMOIS BEND. SHOWING CONSTRUCTION PARTIES AT WORK; THE THREE PILE DRIVERS ON OUTER CIRCLE ABOVE MIDDLE ORDINATE. VIEW TAKEN MARCH 18, 1897. LOOKING DOWNSTREAM. STAGE 3.2 FEET ABOVE S. L. W.



BANK HEAD, CHAMOIS BEND. SHOWING CONSTRUCTION PARTIES AT WORK DRIVING IN OUTER CIRCLE. VIEW TAKEN MARCH 20, 1897. LOOKING UPSTREAM.



BANK HEAD, SHOWING CONSTRUCTION PARTIES AT WORK DRIVING PILES IN OUTER WALL BELOW MIDDLE ORDINATE AND PLACING ROCK IN OUTER WALL. VIEW TAKEN MARCH 24, 1897. LOOKING DOWNSTREAM.

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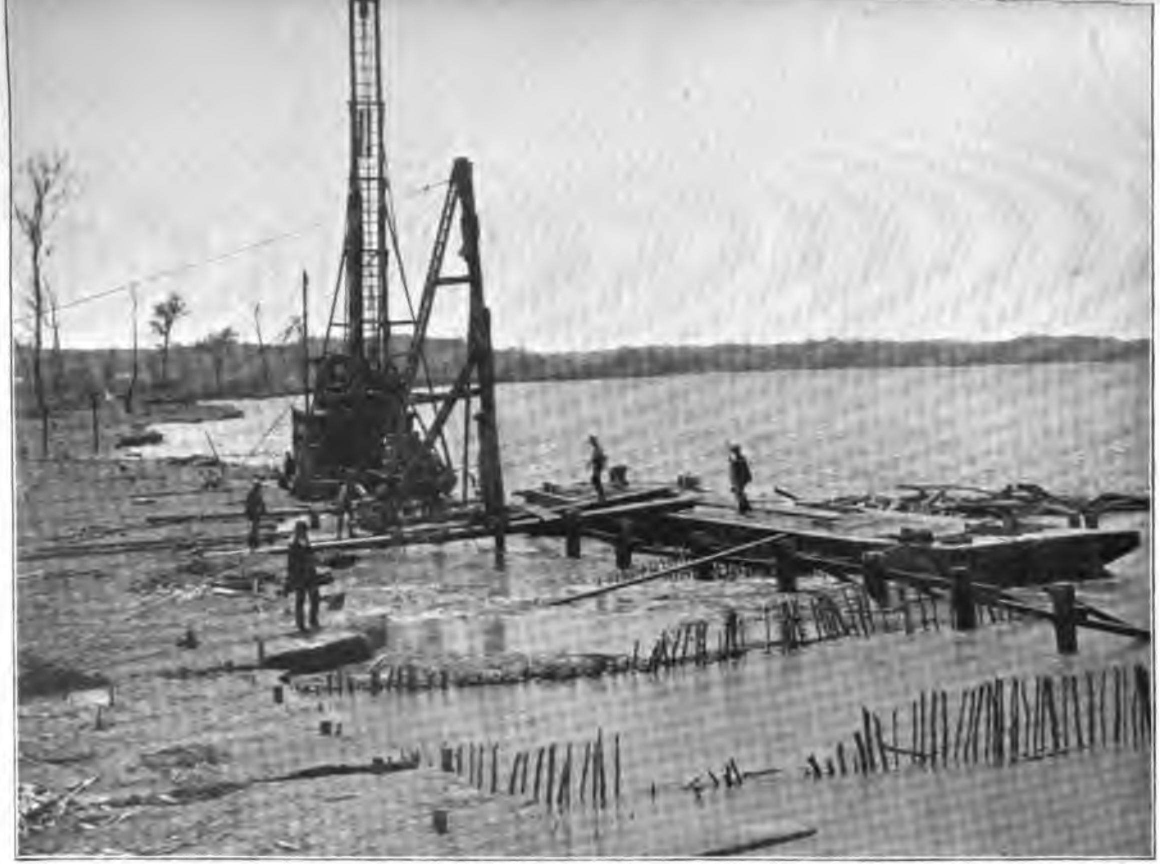
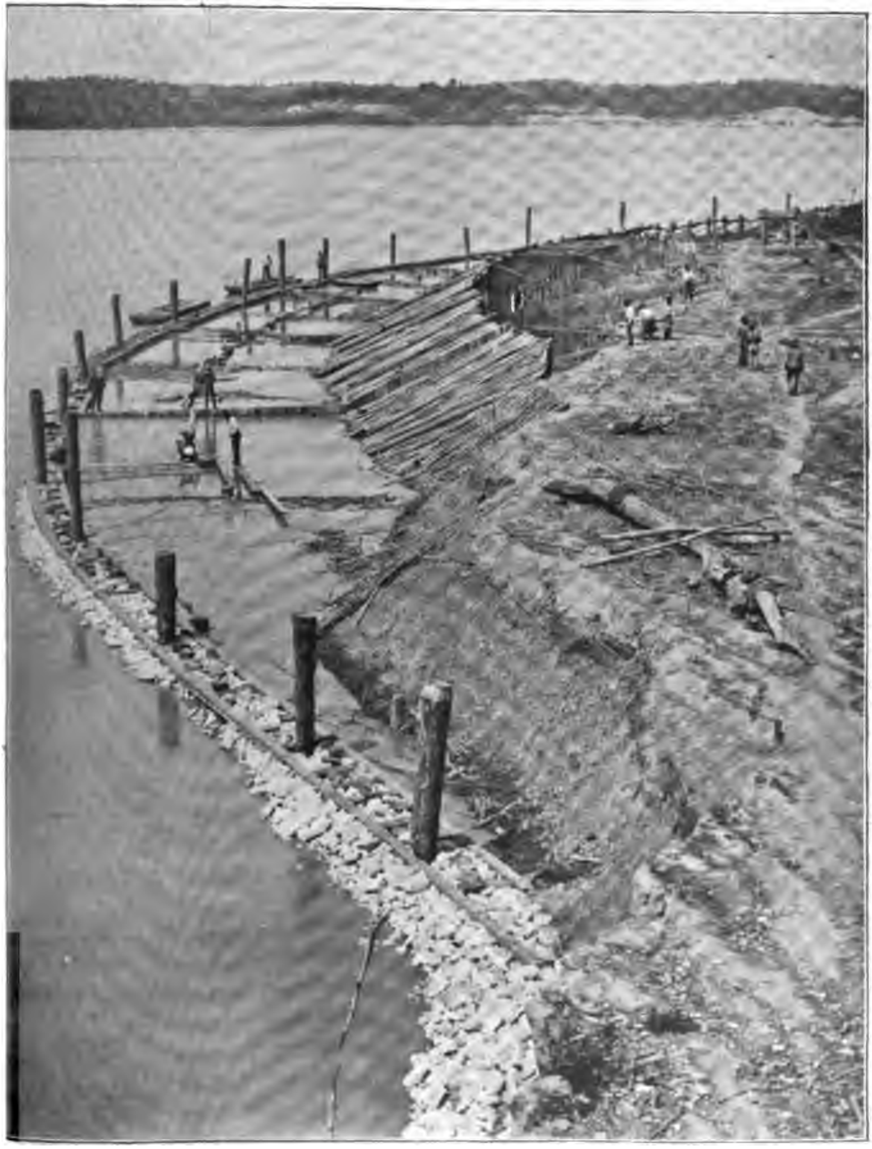
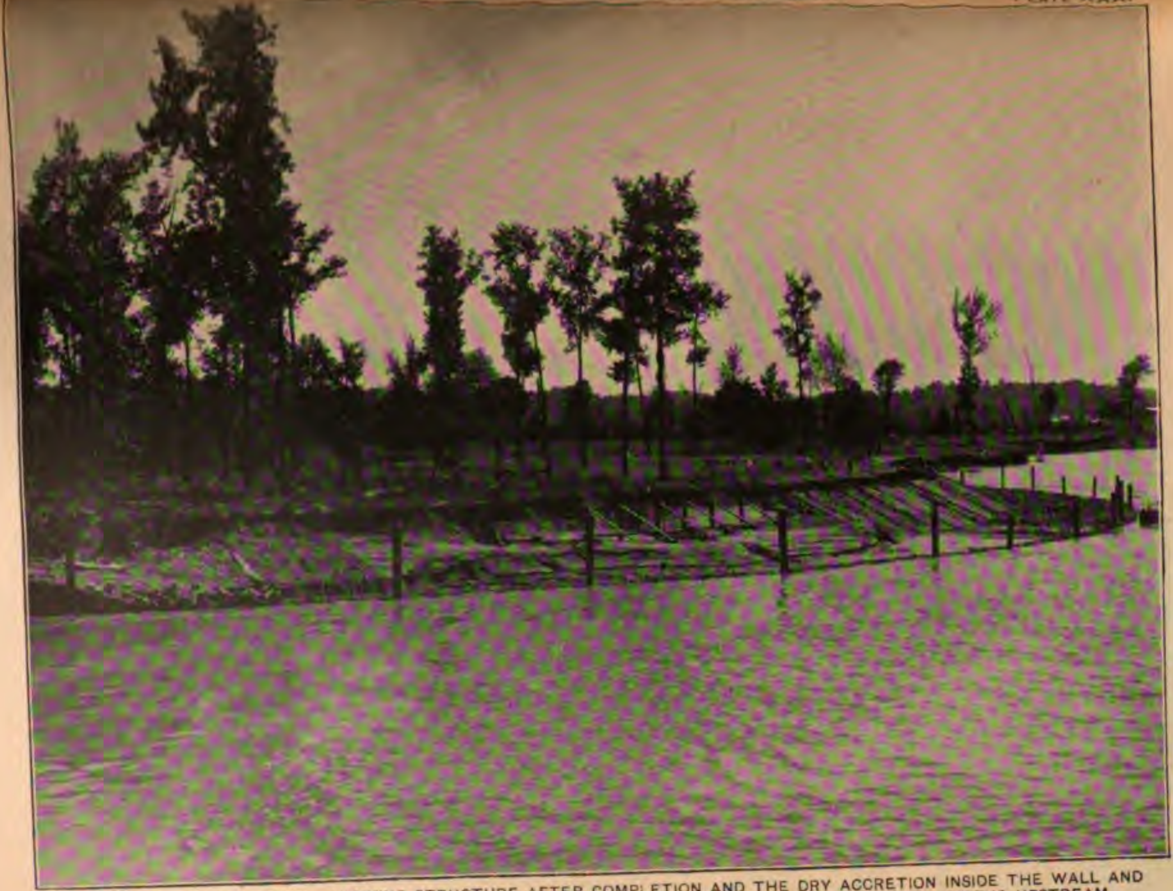


BANK HEAD, CHAMOIS BEND. SHOWING CONSTRUCTION PARTIES AT WORK DRIVING PILES FOR EXTENSION OF UPPER CONE; TARGET 6, ORIGINALLY 50 FEET FROM WATER'S EDGE IS BUT 4 FEET AS SHOWN. VIEW TAKEN APRIL 30, 1897. LOOKING UPSTREAM. STAGE 12.75 ABOVE S. L. W.



BANK HEAD, CHAMOIS BEND. SHOWING CONSTRUCTION PARTY AT WORK PLACING WIRE NETTING FROM OUTER WALL TO FOOT OF UPPER CONE. THE TIGHT BOARD CURTAIN IS THE SECOND ONE FROM UPPER END OF STRUCTURE. VIEW TAKEN MAY 25, 1897. LOOKING DOWNSTREAM.



BANK HEAD, CHAMOIS BEND. SHOWING STRUCTURE AFTER COMPLETION AND THE DRY ACCRETION INSIDE THE WALL AND BELOW THE MIDDLE ORDINATE. STAGE 5.7 FEET ABOVE S. L. W. VIEW TAKEN MAY 29, 1897. LOOKING UPSTREAM.

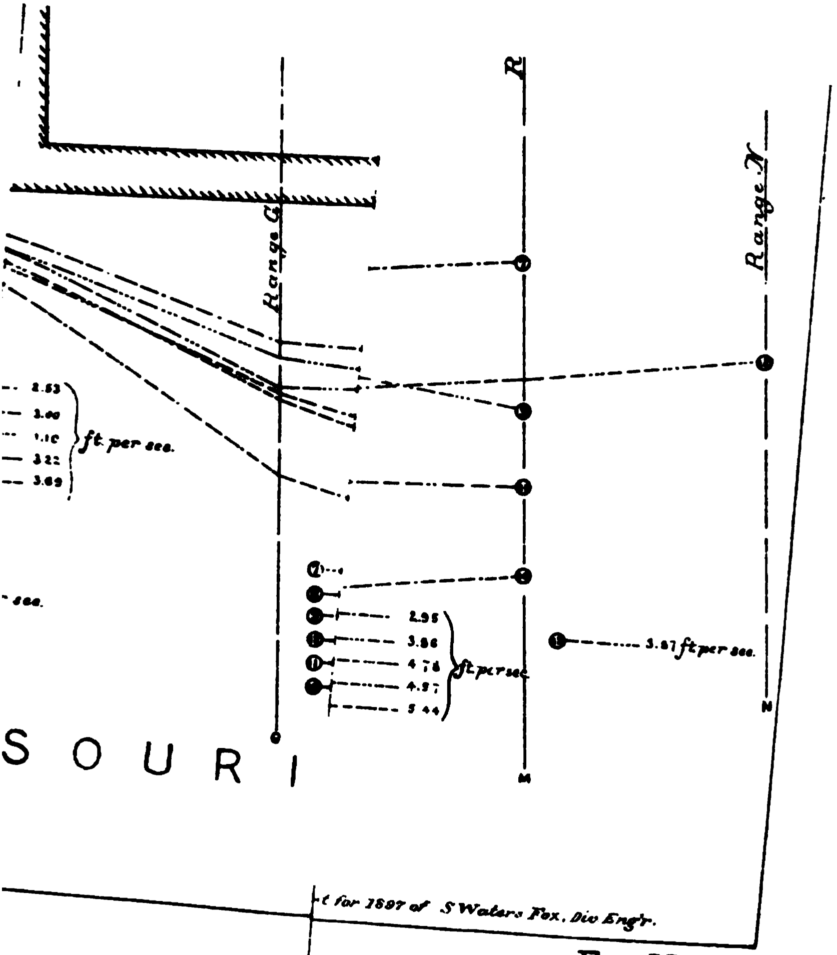

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Plate XXXVI

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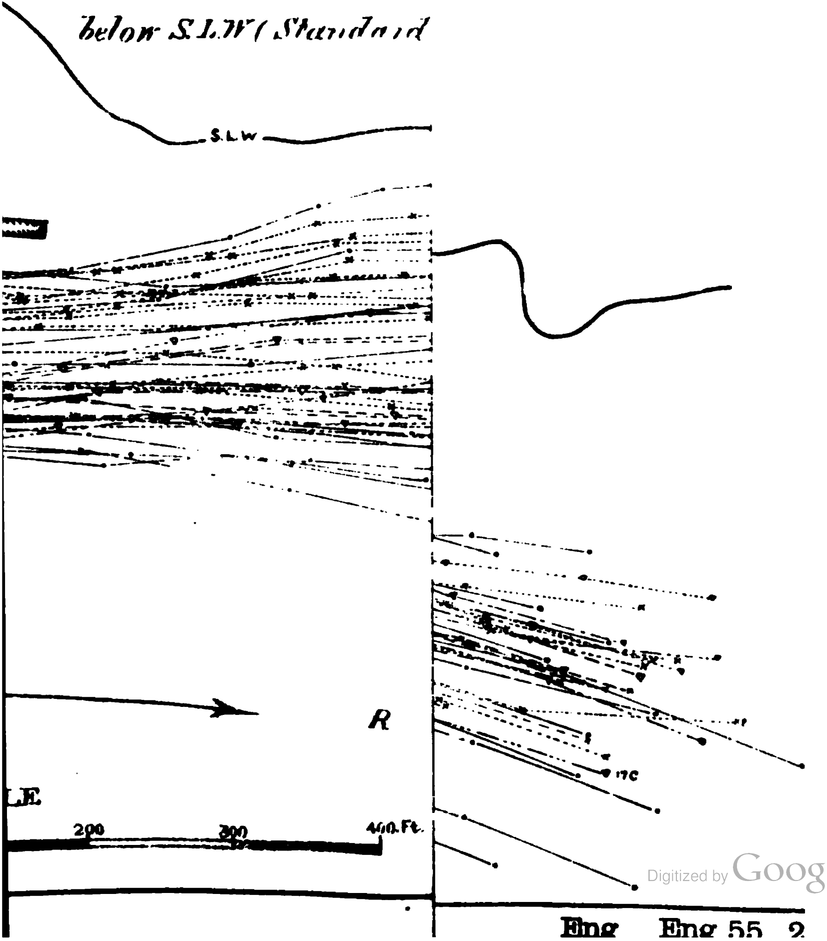

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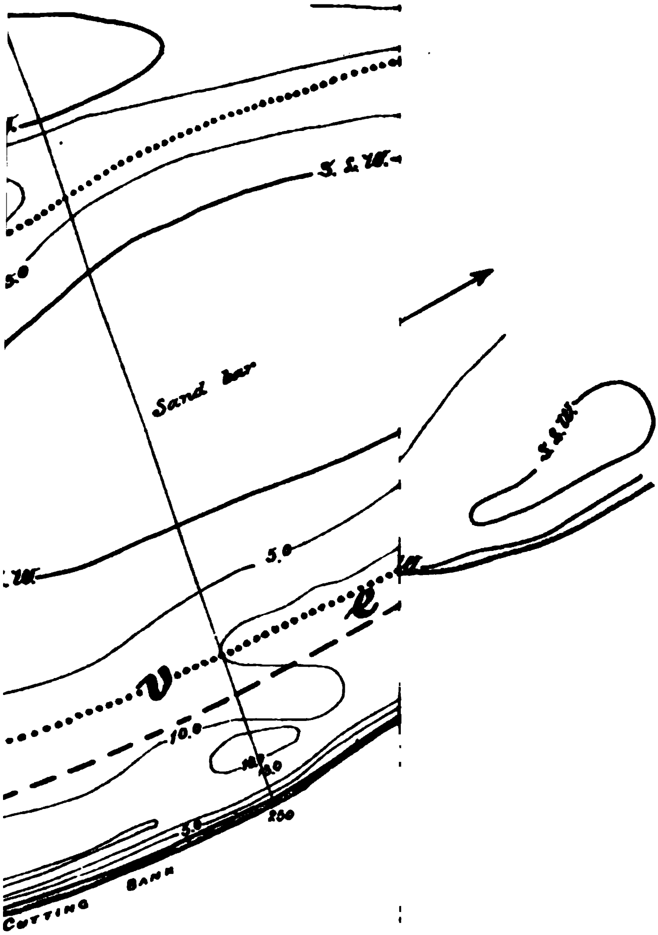

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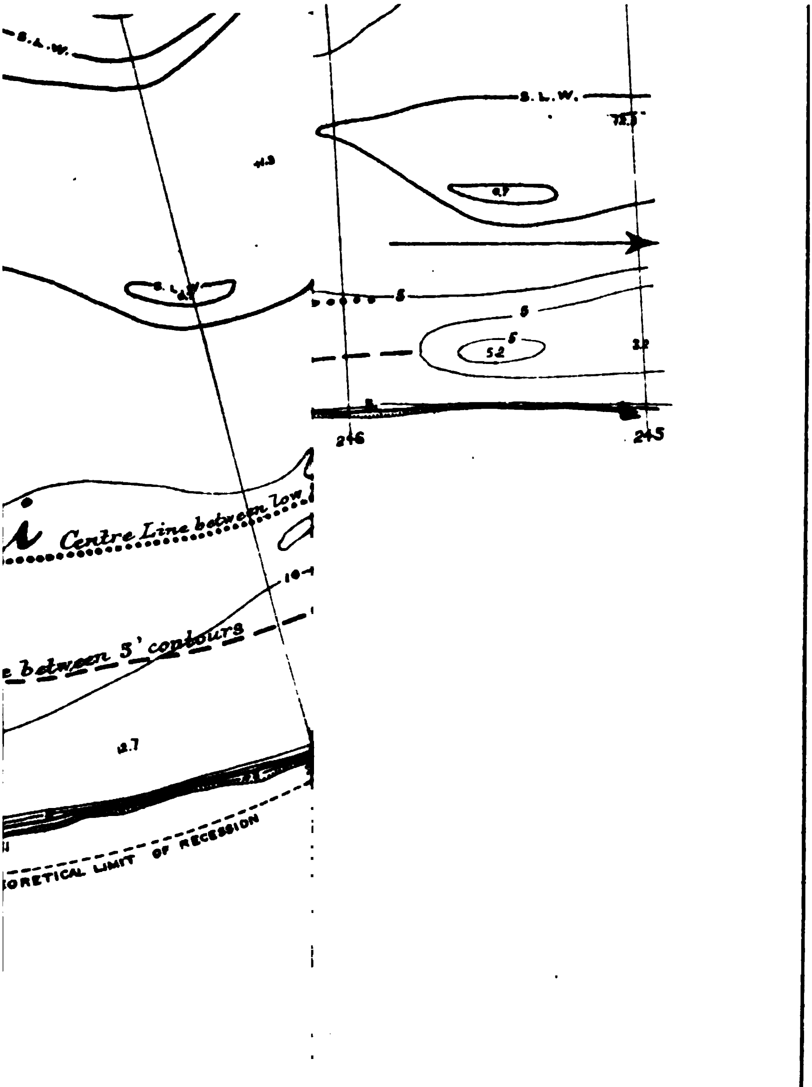

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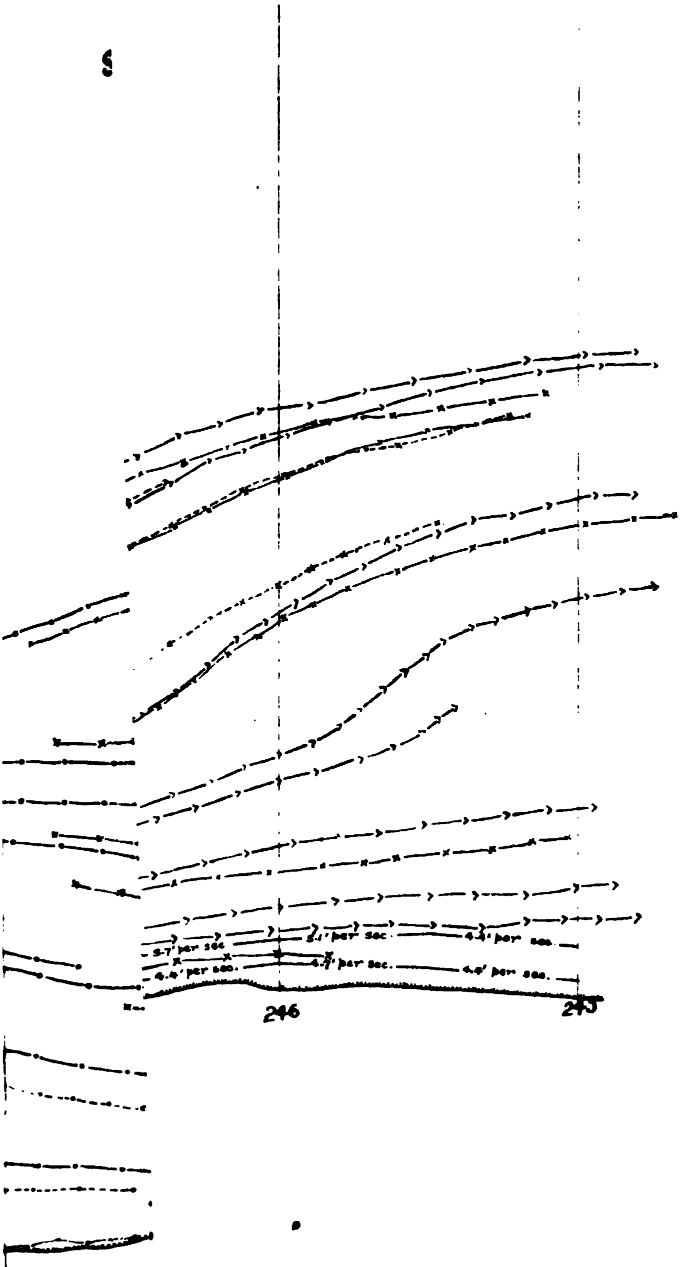

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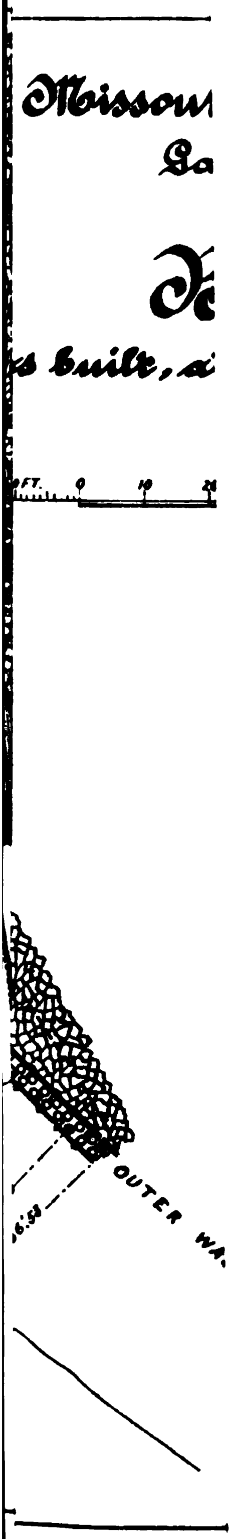
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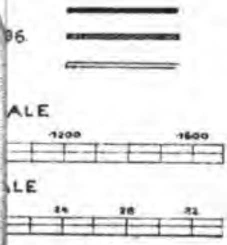
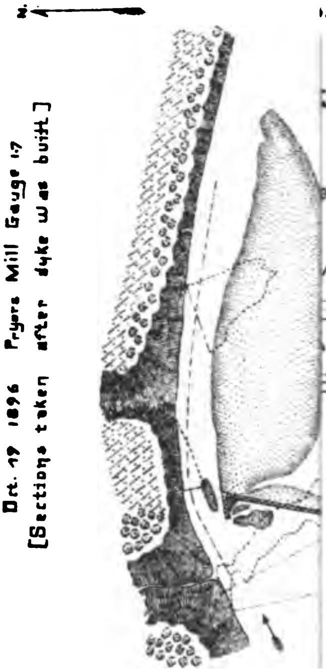


BOCKS BAR.

Oct. 19 1896 Pryors Mill Gauge 1.7

[Sections taken after dyke was built]



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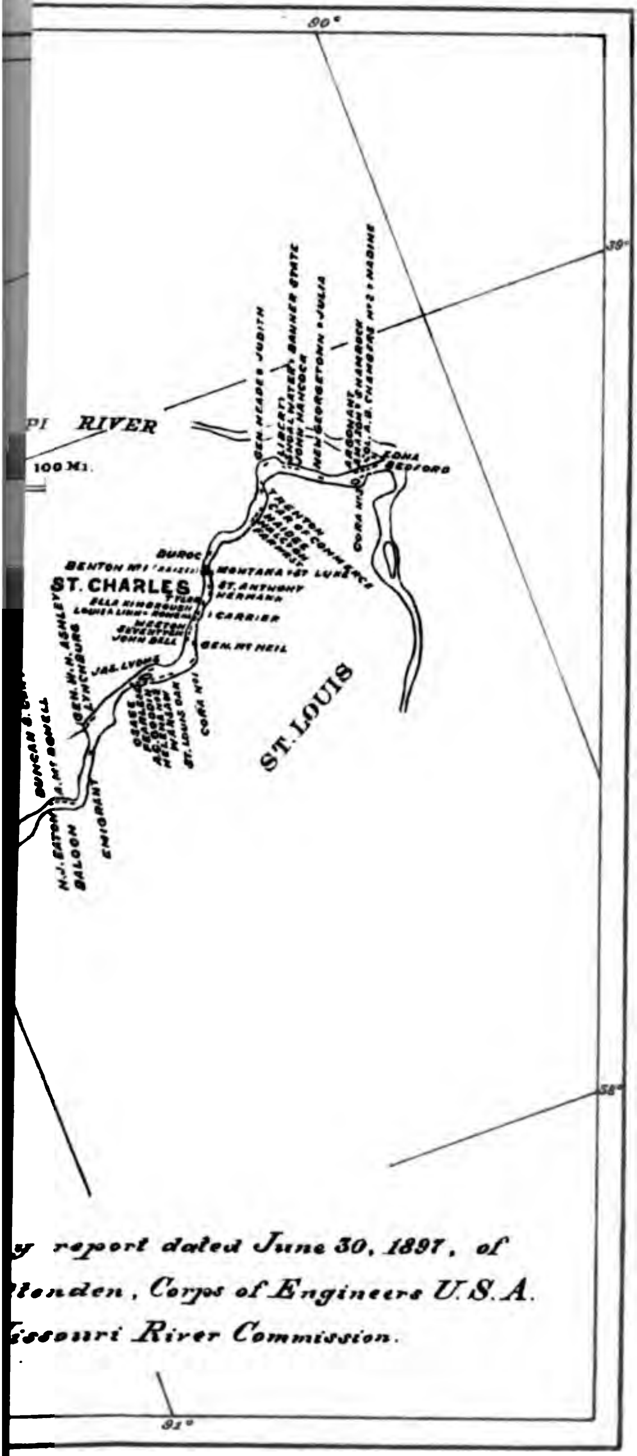

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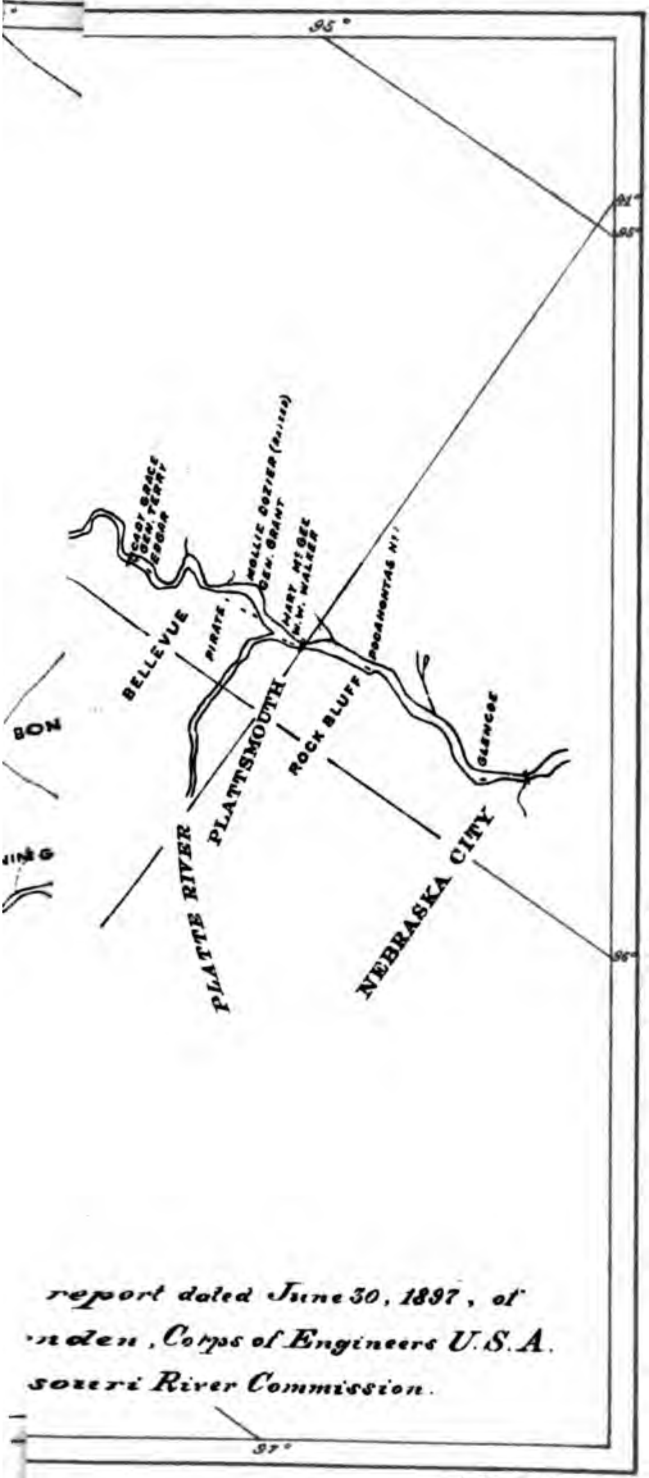
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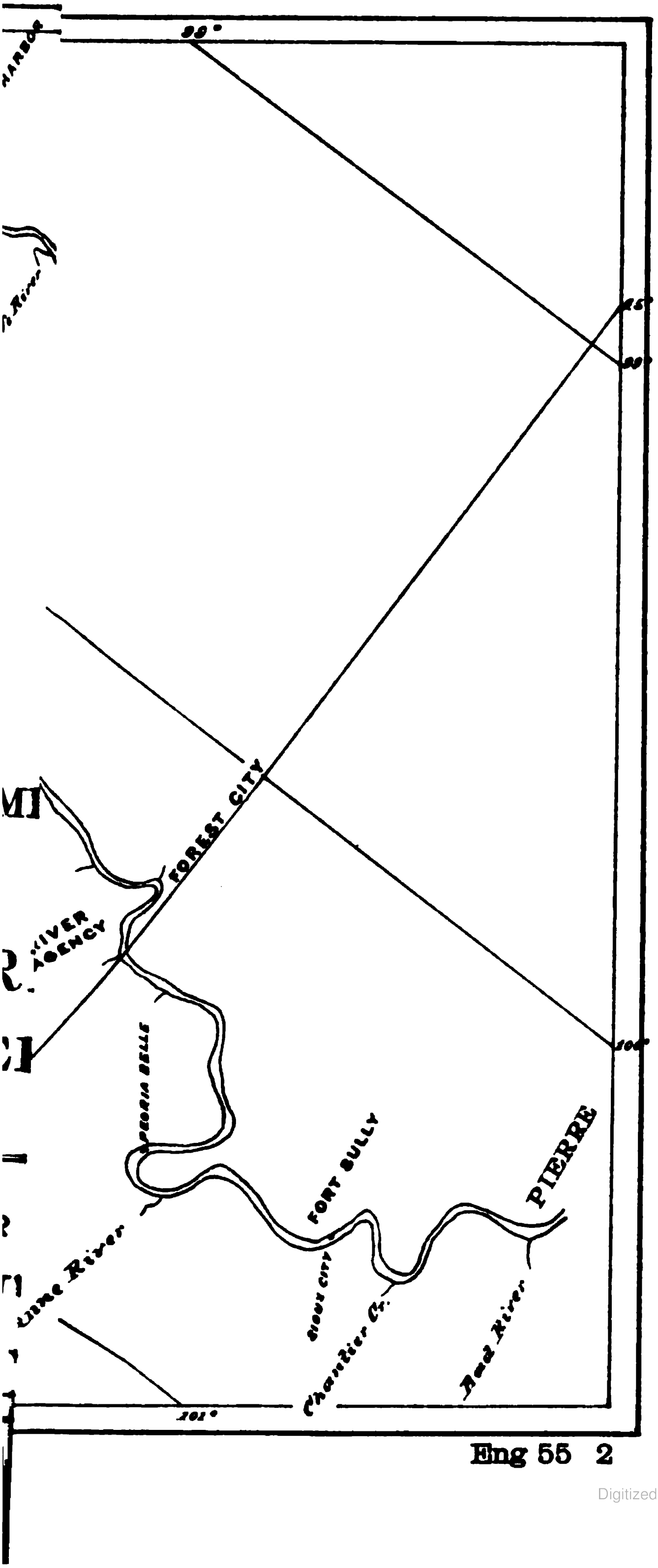
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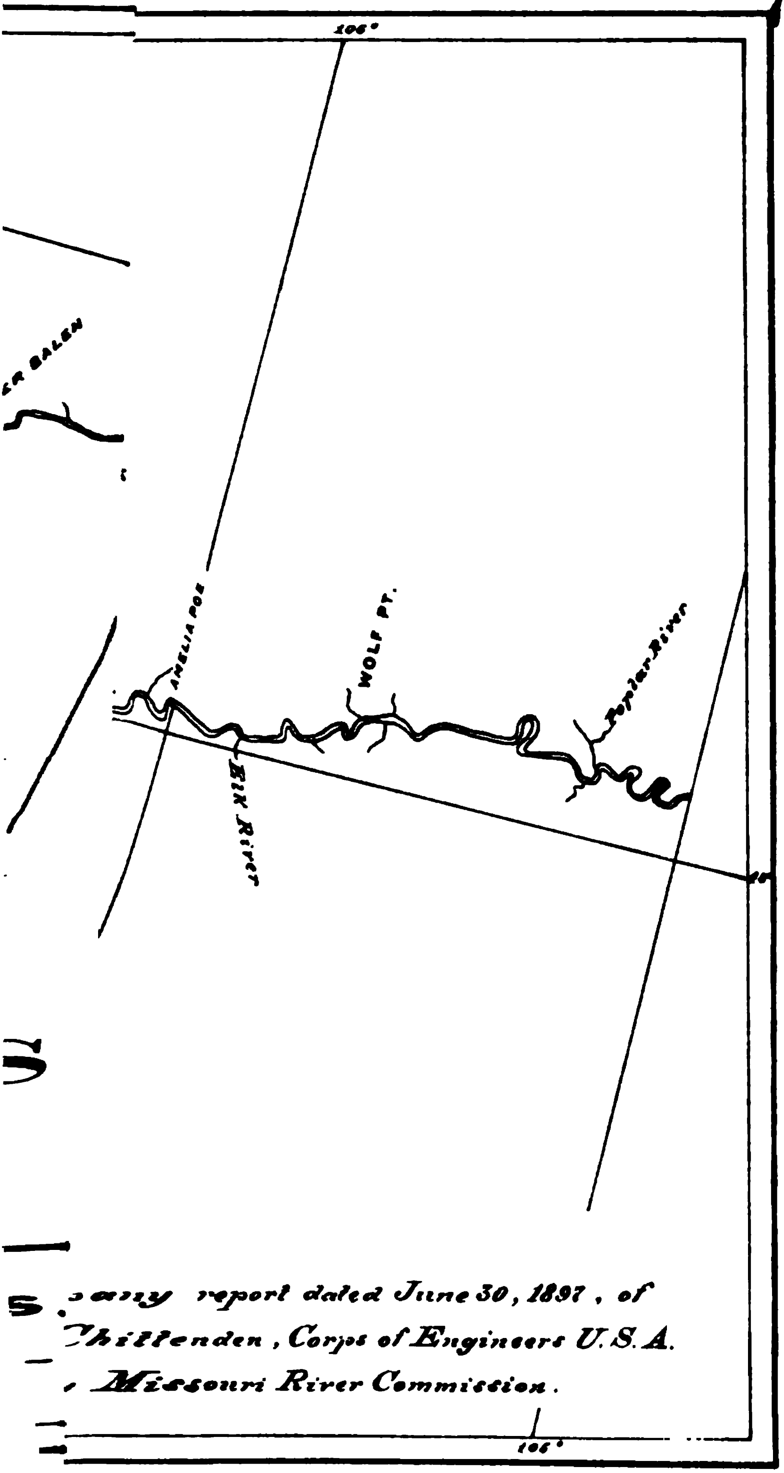

ary report dated June 30, 1897, of
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Missouri River Commission.

APPENDIX X X.

ANNUAL REPORT OF THE CALIFORNIA DÉBRIS COMMISSION FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

CALIFORNIA DÉBRIS COMMISSION,
San Francisco, Cal., July 1, 1897.

GENERAL: The California Débris Commission has the honor to submit the following, its fifth annual report:

The Commission was created by act of Congress approved March 1, 1893. During the past year its members have been the following officers of the Corps of Engineers, viz: Col. Charles R. Suter, president, Maj. Charles E. L. B. Davis, and Capt. Cassius E. Gillette, secretary.

The State Débris Commissioner, the Hon. John F. Kidder, has been present at most of the sessions of the Commission, and has accompanied its members in visiting hydraulic mines.

Mr. Hubert Vischer, civil engineer, has been in the employ of the Commission throughout the year, inspecting the operations of mines working under permits from the Commission, and looking after illegal mining in the district under the Commission's jurisdiction.

The jurisdiction of the Commission extends to hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems in California.

The duties of the Commission may be briefly stated to be: First, the prevention of such hydraulic mining as may be deemed injurious to the navigable waters within the Commission's jurisdiction, permitting, under proper regulation, such mining in cases where it can be carried on without such injury; second, to mature general plans for the improvement of the rivers whose navigability has been injured by hydraulic mining, and, if practicable, to devise general methods whereby such mining may be carried on without damage to the navigable waters.

PREVENTION OF ILLEGAL MINING.

In accordance with the opinion of the Attorney-General of the United States (Appendix A, House Ex. Doc. No. 11, Fifty-third Congress, third session), the Commission has, since the date of its last annual report (July 1, 1896), called the attention of the owners and operators of ten mines, which were being worked illegally, to the requirements of the law and the duties of the Commission in the matter. So far as known, these mines have been closed, and in five cases applications have subsequently been made to the Commission for permits to mine. These mines are all small.

On June 8, 1897, the Commission received notice from the United States district attorney that the injunction suit requested by the Commission on December 4, 1894, against the North Bloomfield Mining Company, had been decided by Judge Ross of the United States circuit court in favor of the United States, and that the injunction had been issued. On June 22 the Commission was informed that an appeal had been taken by the North Bloomfield Mining Company, and that their motion to vacate the injunction pending the appeal had been granted. Under these circumstances it is unknown when an injunction that will cause the cessation of the apparently illegal work of this company will be obtained.

APPLICATIONS AND PERMITS.

The Commission has, since it organized, received 311 applications to mine; 238 permits have been granted. A table showing a synopsis of the applications received and the action taken is appended and marked A.

Eight permits have been canceled and 28 permits have been at different times temporarily suspended, generally on account of the neglect of the owners to comply with instructions concerning the impounding works, or from accidents to those works.

Several of the smaller impounding dams have broken or have been damaged during the year, but none of any importance excepting the dam connected with the Manzanita Mine, near Sweetland, Nevada County. The permit for this mine was canceled January 19, 1897, for irregularities in its management. On January 25, the substantially built crib shaft connecting the settling pool above the dam with the tunnel underneath the dam collapsed from some unexplained cause, and the bulk of the material, about 130,000 cubic yards, stored above the dam, escaped or will eventually escape into the Yuba River. This fact, together with the alleged blowing up with dynamite of a number of large dams in Slate Creek, built before the Commission was appointed, illustrates the difficulty of securing permanent dams for large mines in streams of any magnitude, located, as most of them are, distant from inhabited neighborhoods, and dependent for their maintenance upon owners who have no direct interest in maintaining them.

The total amount of material mined under permits during the year is estimated at 1,256,910 cubic yards. The available storage provided at present and partially or wholly completed for future operations is estimated at 11,000,000 cubic yards.

The requirements in respect to storage of detritus exacted by the Commission during the past year have been the same as those during the previous year.

No dam for impounding detritus in the larger streams has as yet been authorized by the Commission.

IMPROVEMENT OF RIVERS.

The duty of devising plans for the improvement of the rivers concerned devolves upon the Commission by section 4 of the act. A Board, consisting of the same membership as the Commission, has been appointed, in accordance with the act of Congress approved June 3, 1896, and charged with essentially the same duties. Under the latter act the board has been making the necessary surveys of the Sacramento River. This work has not yet been completed.

The same river and harbor act also provides:

> For the construction of restraining barriers for the protection of the Sacramento and Feather rivers in California, two hundred and fifty thousand dollars; and restraining barriers to be constructed under the direction of the Secretary of Wa in accordance with the recommendations of the California Débris Commission, pursuant to the provisions of and for the purposes set forth in section twenty-five of the act of the Congress of the United States entitled "An act to create the Californi

Débris Commission and regulate hydraulic mining in the State of California," approved March first, eighteen hundred and ninety three: *Provided*, That the Treasurer of the United States be, and he is hereby, authorized to receive from the State of California, through the Débris Commission of said State, or other officer thereunto duly authorized, any and all sums of money that have been or may hereafter be appropriated by said State for the purposes herein set forth; and said sums when so received are hereby appropriated for the purposes above named, to be expended in the manner above provided.

The legislature of the State of California on March 17, 1897, passed an act appropriating $250,000 to be used in conjunction with the above appropriation of the United States. This act provides:

Whenever said "California Débris Commission" or the Government of the United States shall have entered into any contract for the construction of works for the purposes described in this act, in pursuance of plans and specifications that have been theretofore approved by the State board of examiners as in this act provided, it shall be the duty of the Débris Commissioner to carefully inspect such works during the process of their construction and to keep a record of the result of such inspection and to report the same monthly to the State board of examiners. Said Débris Commissioner shall also from time to time during the process of the construction of such works, when requested so to do by the said "California Débris Commission," draw his warrants upon the State controller in favor of such person or persons as may be designated by said "California Débris Commission" for such amounts as shall equal one-half of the cost of the construction of said works; and said Débris Commissioner shall in like manner, and when requested so to do by said "California Débris Commission," draw his warrant upon the State controller for an amount equal to one-half the purchase price of any site or sites necessary for the construction of said works: *Provided*, That the purchase of such site or sites shall have been first approved by the State board of examiners: *And provided further*, That no warrant shall be drawn in excess of the amount appropriated by this act.

In compliance with instructions from the Secretary of War, the Commission has been developing a project for the expenditure of the money appropriated by the United States, and it is proposed to make this project so that the money appropriated by the State can be expended under it. The act of the California legislature referred to is appended hereto, marked B.

Money statement.

June 30, 1897, amount unexpended of appropriation for "expenses of California Débris Commission, 1897"	$8,983.54
Outstanding liabilities	10.75
Balance	8,972.79
June 30, 1897, amount appropriated by act of June 4, 1897, for "expenses of California Débris Commission, 1898"	15,000.00
Amount estimated to be necessary for expenses of the Commission to the close of the fiscal year ending June 30, 1899	15,000.00

Respectfully submitted.

CHAS. R. SUTER,
Colonel, Corps of Engineers.
CHAS. E. L. B. DAVIS,
Major, Corps of Engineers.
CASSIUS E. GILLETTE,
Captain, Corps of Engineers.

APPENDIX A.

Synopsis of applications for authority to mine, with action taken thereon.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1893.			*Cub. yds.*	*Cub. yds.*
1	Kelly Hill *a*	Butte	R. M. Mooer	Sacramento	Rock dam 30 feet high in dry ravine; side spillway cut in rock.	1,000,000	Aug. 2	Sept. 9, 1893	Mar. 27, 1894	9,000	....
2	Farrell	Nevada	Eureka Lake and Yuba Canal Co.	Middle Yuba.	Dam 12 feet high, of earth and logs, across mouth of old hydraulic pit.	212,000	Aug. 11	Works already built.	Sept. 8, 1893	125,972	92,800
3	Omega *b*	do	N. C. Tully	South Yuba	Dam 80 feet high in Scotchman Creek, of brush and gravel; side spillway cut in rock.	2,160,000	Aug. 16	Sept. 9, 1893	Nov. 11, 1895	....	1,000,000
4	Brandy City	Sierra	A. Steinberger	Middle Yuba.	Brush and earth dam across mouth of old hydraulic pit.	1,520,000	Sept. 19	Oct. 25, 1893	Oct. 9, 1894	99,800	856,000
5	Blue Nose *c*	Plumas	B. Below	Middle Feather.	Stone dam in Hopkins Creek.	50,000	do	....	....	....	....
6	Blue Gravel	Yuba	Excelsior Water and Mining Co.	Yuba	Old hydraulic pit with tunnel stopped with rock.	604,000	Sept. 27	Works already built.	Oct. 17, 1893	529,614	1,340,000
7	Illinois Gold Gravel.	Plumas	H. Buckley and Louis L. Hillman.	do	do	35,000	Sept. 29	Jan. 4, 1894	Jan. 31, 1894	7,951	91,000
8	New York Gold Gravel.	Sierra	Westall & Hughes	South Yuba	Brush, log, and earth dam, Howard Creek; spillway in rock.	484,000	Oct. 12	Nov. 21, 1893	Dec. 25, 1893	38,040	43,000
9	Corbiere & Bean.	Butte	Corbiere and Bean.	North Yuba.	Rock dam 10 feet high in Hampshire Creek.	12,000	Oct. 9	Works already built.	Nov. 21, 1893	8,650	3,500
10	Phœnix Gold Gravel.	Sierra	W. A. and M. E. Schofield.	do	Dams, Whisky Creek and North Fork of Slate Creek.	1,660,000	Oct. 14	June 27, 1894	....	....	....
11	Eureka Mining Co.	do	Eureka Mining Co.	do	Timber dams in Sam Hill Ravine.	553,000	Oct. 15	Nov. 21, 1893	May 29, 1894	49,120	50,000
12	Craycroft Mining Co.	do	Craycroft Mining Co.	do	Timber dams, Hughes and Davidson ravines.	140,000	do	do	do	30,000	3,000
13	Excelsior Hydraulic.	do	Excelsior Mining Co.	do	Timber dams, Eagle Gulch and Smith Flat.	277,000	do	do	do	31,000	4,000

14	Spanish Ranch	Plumas	Quincy Mining and Water Co.	North Feather	Timber dams, Spanish Creek and old hydraulic pit.	3,000,000	Oct. 18				
15	Gopher Hill	do	do	do	do	2,000,000	do	Dec. 6, 1893	Apr. 14, 1894	384,701	74,441
16	Polar Star d	Placer	John Spaulding	Bear	Stone and gravel dam in Little Bear River, with spillway.	605,000	Nov. 3	Works already built.	Dec. 13, 1893	12,800	
17	Agate	Sierra	A. Denmire	North Yuba	Dams in dry ravine	17,000	Nov. 6	Dec. 13, 1893	Nov. 20, 1894	4,025	16,725
18	Nevada e	do	Geo. W. Cox	Yuba	Dams, North Branch Slate Creek.	10,000	Nov. 14	June 27, 1894			
19	Fifty-four Flat d	Amador	Fifty-four Flat Mining Co.	Mokelumne	Brush dam in ravine	15,000,000	do	Jan. 11, 1894	Feb. 6, 1894	34,446	
20	Red Hill f	Shasta	Nathan Gardiner	Sacramento	Five dams in gulch	750,000	Nov. 16	Jan. 4, 1894	do	10,480	10,000
21	Badger	do	W. R. Stewart	Cottonwood	Flat ground	2,500	Nov. 29	No works required.	Jan. 2, 1894	35	3,000
22	First Chance	Sierra	Frank E. Barbero	North Yuba	Bowlder, log, and brush dam in Howard Creek.	200,000	Dec. 4	Works already built.	do	834	2,992
23	Tannery Ravine	Yuba	W. R. Reed	Yuba	Log and brush dam in ravine.	9,000	do	Jan. 4, 1894	Jan. 10, 1894	70	2,000
24	Mateos	Sierra	Manuel Mateos	North Yuba	Westall & Hughes' dam, Howard Creek.		do	Works already built.	Jan. 2, 1894		
25	Davis	do	Joseph Davis	do	do		do	do	do	12,373	12,000
26	Christmas Hill e	Placer	Hannah McKinstry, E. E. McKinstry and E. E. Gilbert.	American		200,000	Dec. 5				
27	Walker d	Shasta	Olonso Engle and F. Walker.	Cottonwood	1 rock and 1 brush dam in Pomroy Gulch.	675,000	Dec. 8	Jan. 4, 1894	Jan. 31, 1894	1,076	
28	North Star d	Calaveras	Phil. McGuire, P. McGuire, jr., and B. McGuire.	Mokelumne	Dams in Buckeye Gulch.	500,000	Dec. 13	do	Jan. 10, 1894	31,618	
29	Hustler g	Nevada	Joseph Hustler	South Yuba	Gravel dam in Gilroy Cut.	90,000	Dec. 17	Jan. 31, 1894	Aug. 18, 1894	19,850	2,270
30	Green Mountain. d	Calaveras	J. W. Smith	Calaveras	Old hydraulic pit with brush dam.	250,000	do	Jan. 4, 1894	Jan. 8, 1894	3,534	
31	Noonday	Sierra	John Egbert	North Yuba	Flat near mine	40,000	Dec. 26	No works required.	Oct. 23, 1894	8,775	39,975
32	Pomroy d	Shasta	John McGrew and Olonso Engle.	Cottonwood	Rock dam in Pomroy Gulch.	1,400,000	do	Works already built.	Jan. 31, 1894	3,737	
33	Union	Yuba	C. C. Beever	Yuba	Rock and brush dam, French Gulch.	3,200	do	Mar. 7, 1894	Mar. 27. 1894	605	3,000
34	Welch Placer	Sacramento	Columbia Gold Mining Co.	Cosumnes	Stone dam	161,000	Dec. 27	Jan. 31, 1894	Feb. 10, 1894	380,704	375,000
35	French Corral	Nevada	Kate Hayes Mining Co.	South Yuba	Old hydraulic pit	450,000	do	do	Mar. 13, 1894		
36	Manzanita h	do	do	Main Yuba	do	1,159,500	do	Apr. 10, 1894	May 1, 1894	833,200	
37	Campo	Yuba	Fausteno Campo	Yuba	Rock dam in gulch	1,000	Dec. 29	Works already built.	Mar. 7, 1894		

a Mine closed; permit canceled.
b Permit canceled April 12, 1897.
c Permit refused.
d Mine closed.
e Mine will not be worked.
f Lower dam broke October 23, 1894.
g Dam broke November 25, 1894.
h Permit canceled January 19, 1897.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1894.			*Cub. yds.*	*Cub. yds.*
38	Herring Ravine.	Yuba	J. M. Wetmore	Yuba	Rock and brush dam 1 mile below mine.	660	Jan. 10	Works already built.	Mar. 7, 1894	390	....
39	Conduit Ravine.	...do	W. W. and W. A. Lemon.	...do	Rock and brush dam	10,000	Jan. 21	Mar. 7, 1894	....	....	....
40	Motor	...do	Jas. Gordon	...do	Old water reservoir	10,000	...do	No works required.	Mar. 7, 1894	200	1,000
41	Spring Gulch *a*	Calaveras	J. S. White	Calaveras	Old reservoir and dams, Spring Gulch.	545,000	Jan. 31	Works already partly built.	Mar. 13, 1894	27,100	....
42	Crane Bros. *b*	Yuba	Crane Bros	Yuba	No impounding works required.	1,000	Feb. 5	No works required.	Mar. 7, 1894	....	....
43	Indian Hill *c*	Plumas	F. Eyraud and Jean Lassier.	Feather	Dam across natural depression.	118,000	Feb. 6	....	....	....	....
44	Badger Hill	...do	E. B. Jacks	...do	Quincy mining and Water Co.'s dam in Spanish Creek.	100,000	Feb. 7	....	....	....	....
45	Snow Bros	El Dorado	Snow Bros	American	Timber and brush barrier, Webber Creek.	903,000	Feb. 13	Works already built.	Apr. 3, 1894	58,380	78,600
46	Green Meadow	Calaveras	H. B. Havens	Mokelumne	Brush dams in gulch	93,000	Feb. 15	Mar. 14, 1894	Apr. 17, 1894	27,345	5,000
47	Grub Flat	Plumas	John Tucker and S. C. Brown.	Feather	Brush and log dam in old pit.	20,000	...do	Apr. 10, 1894	Apr. 14, 1894	5,615	2,000
48	Oriental and Tahoe.	Nevada	Jas. Hackett	Yuba	Brush dam in swale and brush barrier on sloping plain.	56,000	...do	Apr. 3, 1894	Aug. 6, 1894	1,340	12,000
49	Eureka Hydraulic. *d*	El Dorado	Pascoe & Gruben.	American	Brush dam, Chili Ravine.	24,200	Feb. 19	...do	Apr. 10, 1894	10,100	....
50	Spanish Hill Hydraulic.	...do	Eldorado Water and Deep Gravel Mining Co.	...do	2 brush dams in Spanish Ravine.	129,000	...do	Mar. 28, 1894	...do	5,250	8,000
51	Spanish Hill gravel. *a*	...do	Thos. Alderson	...do	Brush dam on flat	193,000	...do	...do	...do	....	....
52	Cleveland	Sierra	D. Perkins	North Yuba	Log dam, Rock Creek	125,000	Feb. 24	June 27, 1894	Nov. 27, 1894	10,100	35,000
53	Dutra, Wilder & Co.	Yuba	Lewis Wilder	Yuba	Rock dam across ravine.	120,000	Mar. 5	Oct. 23, 1894	Feb. 5, 1895	1,000	3,400
54	Mitchell Hydraulic.	El Dorado	Robt., Jas., and John Blair.	American	Brush and gravel dam in ravine.	1,161,000	Mar. 7	Oct. 9, 1894	Oct. 23, 1894	11,813	11,000
55	Stewart Hydraulic.	...do	John Melton	...do	Brush dam in ravine	7,250	Apr. 3	Works already built.	May 1, 1894	....	....

56	Nip and Tuck	Butte	Dickhouse Bros.	Feather	Dam on flat in Robinson Ravine.	12,700	Apr. 19	Sept. 25, 1894	Oct. 2, 1894	1,000	2,000
57	Concordia [e]	Plumas	L. V. Tefft	do	Dams, Cogswell Ravine and Jackson Creek.	1,450,000	May 16	July 3, 1894			
58	Northern Placer	do	Northern Placer Mining Co.	do	Dams, Little Long Valley Creek.	100,000	do	June 27, 1894	Nov. 6, 1894	24,460	
59	Schuyler	Shasta	Thos. White	Sacramento	1 rock and 2 brush dams in Dry Creek.	296,800	June 5	Works already built.	July 23, 1894	11,450	20,000
60	Hayes & Steelman.	Sierra	Phillip Hayes	Feather	Log and brush barriers in excavations.	150,000	June 12	Oct. 23, 1894			150,000
61	Mohawk	Plumas	Stephen Soracco	do	Log and brush dam in ravine.	16,000	July 17	Aug. 14, 1894	Mar. 30, 1896	466	5,000
62	William Tell [f]	do	Frank F. Vanzini	do	Log and brush dam in Yankee Ravine.	24,000	do	do			
63	Garfield Flat	do	Peter Lorenzo	do	Log and brush dams, Squirrel Creek.	30,000	do	do	Nov. 6, 1894	2,524	2,500
64	Grizzly Bear	do	Nicola Rossi	do	Common reservoir	80,000	do	do	do	5,037	42,775
65	Howard	Shasta	Jas. Regan and J. M. Lowe.	Sacramento	2 brush dams in ravine	4,500	July 18	Oct. 2, 1894			
66	China Hill	Amador	Consolidated Amador Volcano Hydraulic Gold Mining and Land Co., of California.	Mokelumne	Log and brush dam in south branch of Sutter Creek.	968,000	July 25	Aug. 14, 1894	Nov. 13, 1894	6,649	16,666
67	Elephant	do	do	do	Log and rock dam in dry gulch.	330,000	do	do			
68	Steel & Co.	Yuba	T. H. Steel	Yuba	Stone dam on New York Flat.	145,000	do	Works already built.	Sept. 25, 1894	80.000	64,700
69	James Watson	Shasta	J. C. Voluntine	Sacramento	Brush dam Dry Creek and Jackass Gulch.	1,000,000	July 30	Oct. 9, 1894	Mar. 12, 1895	172,000	150,000
70	Volcano Gold Gravel.	Amador	Volcano Gold Gravel Mining Co.	Mokelumne	Log and brush dam, Sutter Creek.	32,000	Aug. 16	Sept. 18, 1894	Nov. 13, 1894	15,000	15,000
71	Holloway	Plumas	J. S. Gould and F. M. Spencer.	Feather	Log and brush dam in canyon.	30,000	Sept. 5	Works already built.	Nov. 20, 1894	33,914	35,000
72	Mugginsville	Sierra	W. A. Morse	North Yuba	Crib dam in Eureka Creek.	450,000	Sept. 7	Oct. 30, 1894	Nov. 11, 1895	22,000	20,000
73	Waukshaw	Nevada	John R. Jones	South Yuba	Rock dam in canyon	150,000	Sept. 10				
74	U. S. Grant [g]	do	E. P. Hagar and Samuel Peck.	do	Three brush dams in dry canyon.	25,000	Oct. 23	Nov. 27, 1894	Dec. 17, 1894	3,300	
75	Richmond Hill	Plumas	Good Hope Mining Co.	Feather	Log crib dam in Onion Valley Creek.	72,000	Oct. 24	do	Nov. 18, 1895	98,066	100,000
76	Pine Grove [g]	Amador	Ben Hur Mining Co.	Mokelumne	Brush dam, Sawmill Gulch.	25,000	Nov. 8	do	Jan. 8, 1895	4,000	2,000
77	Hidden Treasure.	do	Chas. G. Haskin	do	Log and rock dam in Grass Valley Creek.	30,000	do	do	Mar. 30, 1896	23,066	25,000
78	Martelle	El Dorado	Leonard Dormody	American	Martelle Creek	30,000	do	Jan. 22, 1895	Feb. 18, 1895	200	100

[a] Mine closed.
[b] Mine worked out.
[c] Permit refused June 27, 1894.
[d] Dam broke January 4, 1895; mine closed.
[e] Permit refused February 23, 1897.
[f] Permit refused November 6, 1894.
[g] Mine closed; permit canceled.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1894.			*Cub. yds.*	*Cub. yds.*
79	Gold Run	Placer	Gold Run Ditch and Mining Co.	American	Two rock dams, north fork of American River.	11,655,000	Nov. 3				
80	Spanish John	Nevada	John Black	Yuba	Log and brush dams in blind ravines.	121,000	Nov. 8	Nov. 27, 1894	Dec. 17, 1894	17,255	20,000
81	North Rim	Placer	G. H. Pease and J. B. Colwell.	American	Dam, Mexican Gulch	10,000	Nov. 20	Feb. 12, 1895	Feb. 26, 1895	4,000	6,000
82	Crown Point	Plumas	Crown Point Mining Co.	Feather	Log and brush dam, Porter Ravine.	45,000	Nov. 26		Apr. 15, 1895	2,850	9,000
83	Spring Valley[a]	Butte	Mariano C. Mello and John Costa.	do	Rock dam, Sawmill Gulch.	484,000	Dec. 3	Feb. 26, 1894	July 20, 1896	18,750	
84	Kentucky Flat	El Dorado	H. E. Picket	American	Log and brush dam, North Otter Creek.	100,000	Dec. 5	Works already built.	Feb. 5, 1895	22,758	75,000
85	Johnson	Amador	William Johnson.	Sacramento	Brush dam in ravine	100,000	Dec. 10	Jan. 15, 1895			
86	Henrietta[b]	El Dorado	Eldorado Water and Deep Gravel Manufacturing Co.	American	do	7,000	Dec. 11	Works already built.	Jan. 22, 1895	750	
87	Leroy Hedge	Yuba	Leroy Hedge	Yuba	Brush, log, and rock dam below mine.	2,500	Dec. 14	do	Feb. 5, 1895	500	2,808
88	Epley	El Dorado	Louis Rolland and Alonzo Vanderberg.	American	Brush, gravel, and rock dam in ravine.	3,500	Dec. 18	do	Jan. 22, 1895	200	800
89	York Mining Co.	Yuba	York Mining Co.	Yuba	Brush and log dam below mine.	4,000	Dec. 20	do	Feb. 5, 1895	10,000	12,000
90	Last Chance	El Dorado	Edward Hancock and W. H. Daly.	American	Brush and gravel dams, Hancock Ravine.	50,000	Dec. 21	do	Jan. 22, 1895	8,060	8,000
91	Goodman & Bund.	Amador	Goodman & Bund.	Mokelumne	Timber and brush dam, Ashland branch Sutter Creek.	100,000	Dec. 24	do	Jan. 14, 1895	5,250	19,750
92	Goodman Bros.	do	F. A. Goodman and W. H. Goodman.	do	do.	50,000	do	do	do	1,570	2,000
93	'49 Flat	do	Geo. W. Hadley and —— Bolles.	do	Log and brush dam in '49 Gulch.	250,000	Dec. 26	do	do	24,900	20,000
94	Fine Gold	Calaveras	G. A. Meincke, C. Sanguinette, and J. S. Shepherd.	Stanislaus	Rock and brush dam, Skunk Ravine.	4,000	Dec. 27	Feb. 26, 1895	Mar. 5, 1895	30,600	1,900

95	American House.[c]	Plumas	A. Blair	Feather	Dams, American House Ravine.	2,500	1895. Jan. 7		May 13, 1895	207	
96	Central Hill Placer.	Calaveras	Wm. Thomas, sr., M. McCormick, W. A. Bisbee, and W. Thomas, jr.	Stanislaus	Rock and stone dams	1,000,000	...do		Mar. 25, 1895	14,380	190,300
97	Kate Gray	Amador	Giovanni Rossi	Mokelumne	Brush dam	10,000	...do	Feb. 26, 1895	Mar. 5, 1895	600	13,000
98	Spring Tunnel and Spring Canyon.	El Dorado	Jay E. Russell	American	Brush dams, Spring Canyon.	56,000	Jan. 17	Apr. 23, 1895			
99	Shealor	Amador	J. E. Newson	Mokelumne	Log, rock, and brush dam, Sutter Creek.	1,500	Jan. 29	Works already built.	Mar. 5, 1895	250	1,250
100	Railroad Hill Gravel.	Calaveras	Giani, F. T. Luigi, and Luigi Demartini.	Calaveras	Brush dam in dry gulch.	48,000	Feb. 1	...do	Feb. 26, 1895	11,000	13,300
101	James Slater	Yuba	James Slater	Yuba	York Mining Co.'s dam.	30,000	Feb. 4	...do	...do		
102	Grizzly Hill	Amador	Moy Jin Mun	Mokelumne	Brush dam in ravine	300,000	Feb. 12	Mar. 19, 1895	Apr. 8, 1895	180	4,920
103	Deer Valley	El Dorado	Wulf Bros	American	Log and brush dams and old pit.	5,000	Feb. 13	Works already built.	Mar. 18, 1895		5,000
104	Strawberry Placer.	Calaveras	John Enos	Stanislaus	Two rock dams in dry gulch.	3,000	...do	...do	...do	1,855	1,590
105	Mount Gregory Gold.	El Dorado	Porter Phillips	American	Brush and log dam in dry ravine.	200,000	Feb. 20	...do	Apr. 22, 1895		
106	Red Hill and Telegraph Hill.	Amador	Geo. R. Evans, John Erickson, and M. Fitzgerald.	Mokelumne	Log crib dam in Chili Gulch.	15,000	Feb. 23	...do	Mar. 18, 1895	7,810	2,150
107	Blacklock	El Dorado	Geo. W. Edwards.	American	Brush and gravel dam in Spanish Ravine.	403,000	Mar. 1	...do	Apr. 1, 1895	4,740	
108	Kelly & Natherly.[d]	Placer	M. A. Kelly and W. H. Natherly.	Sacramento	Worked-out pit, Rattlesnake Bar.	20,000	Mar. 5				
109	Dry Gulch	Amador	O. M. Henry		Brush dam below mine	10,000	Mar. 7	Works already built.	Apr. 8, 1895	500	1,000
110	Sawmill Flat	Shasta	J. K. Williams	Sacramento	Worked-out pits	30,000	Mar. 8	Mar. 13, 1895			
111	Mooney Placer	El Dorado	Thomas Ewing	American	Log and brush dams, worked-out pit.	968,000	Mar. 13	Works already built.	Apr. 1, 1895	3,000	5,000
112	Grizzly Flat	...do	Geo. Wheeler and Moses C. Wheeler.	Cosumnes	Log and brush dam, Grizzly Flat.	10,000	Mar. 16	Apr. 1, 1895	...do		
113	Gold Deposit	...do	David Croft	American	Retaining wall, old hydraulic pit.	18,000	Mar. 22	Works already built.	Apr. 22, 1895	1,828	17,177
114	Railroad Placer	...do	Wm. Franklin Coe	...do	Brush dam on mine property.	3,000	Mar. 23	Apr. 23, 1895	Sept. 30, 1895	410	1,783
115	Independence	Yuba	John A. Broyles	Yuba	Letsom Ravine	1,800	Mar. 27		Mar. 17, 1896	375	500
116	J. C. Day	El Dorado	J. C. Day	American	Brush dam in ravine	1,000	...do	Apr. 23, 1895	Mar. 30, 1896	418	500
117	Iowa	Placer	Wm., Hy., and John Henning.	...do	...do	1,150	Mar. 29	...do	May 13, 1895	1,450	1,500

[a] Permit canceled March 23, 1897. [b] Mine worked out. [c] License suspended June 24, 1895. [d] Permit refused April 8, 1895.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1895.			*Cub. yds.*	*Cub. yds.*
118	Tiger	Placer	Jas. Ward and Wm. McDonald.	American	Brush dam in ravine	7,000	Apr. 1	Apr. 23, 1895	May 13, 1895	1,475	1,000
119	Hard Times	do	Jos. J. and A. A. Hoffmann and H. McDonald.	do	Brush barriers and old hydraulic pit.	30,000	do	Works already built.	Apr. 22, 1895	1,650	7,000
120	Eldorado Placer	El Dorado	Wm. and W. J. S. Bacchi.	do	Brush dam in small stream.	4,000	Apr. 3	do	do	1,299	2,701
121	Zantgraf & Closs.	do	J. Zantgraf and J. J. Closs.		Worked-out pit	4,200	Apr. 9	do	Apr. 29, 1895		4,200
122	St. Lawrence [a]	Nevada	Ah Wing	Yuba	Brush dam in Illinois Canyon.	150,000	Apr. 15	July 2, 1895	Oct. 28, 1895	3,900	
123	Polar Star [b]	Placer	John Spaulding	Bear	Liberty Hill Dam in Bear River.	2,000,000	Apr. 17				
124	Liberty Hill [b]	Nevada	T. G. Phelps	do	do	144,000	Apr. 25				
125	Lost Camp	Placer	J. B. Rathburn et al.	American	Log and brush dam in Woods Ravine.	180,000	Apr. 29	Aug. 5, 1895	Dec. 16, 1895	22,600	30,000
126	McFadden	Calaveras	A. J. Mason	Mokelumne	Rock and brush dam, Buckeye Gulch.	240,000	May 27	June 17, 1895			
127	Joubert	Sierra	Frederick Joubert.	Yuba	Old pits and dams, Willow Creek.	420,000	June 3	June 15, 1895	July 15, 1895		255,000
128	Sailor Boy	do	Michael Cortes	do	Brandy City Mine's dam.	20,000	do	Works already built.	Aug. 5, 1895		
129	Plumas Imperial.	Plumas	Plumas Imperial Gold Mining Co.	Feather	Rock dam in Rock Creek.	120,000	June 11		July 8, 1895	37,500	366,000
130	Horse Valley	Yuba	M. V. Turner, Mrs. F. M. Brown, and Wm. Wellman.	Yuba	Brush dam in Horse Creek.	12,000	do	July 16, 1895			12,000
131	Youngs Hill	do	Wm. Wellman	do	Brush dams in a dry gulch.	5,000	do	do			7,500
132	Atom	do	E. C. Cochran and Charles Turner.	do	Brush dams in Williamson Creek.	70,000	do	do			25,000
133	Galena Hill	do	W. R. and M. J. Williams.	do	Old hydraulic pit, Galena Hill.	84,000	do	July 15, 1895	Nov. 25, 1895	8,975	2,200
134	Tippecanoe	Sierra	George Parent	do	Brush dam in Spanish Ravine.	32,000	do	do	Oct. 28, 1895	13,830	22,500
135	O'Keeffe	do	D. R. O'Keeffe	do	Closing waste cuts, hydraulic pit.	6,000	June 15	July 23, 1895			6,000

136	Charcoal Ranch	....do	L. F. Fourier and John Barrere.	....do	Flat adjacent to mine	150,000	....do	Works already built.	July 23, 1895	813	14,500
137	Sharp	....do	E. C. Kendall, J. C. Peterson, and H. Kimball.	....do	Brush dam, Sharp Ravine, old pit and reservoir.	200,000	June 24	Aug. 5, 1895	....	....	200,000
138	Homestake	....do	C. Wichman, W. Elkins, W. R. and B. F. Atkinson.	Feather	Dam, blind ravine	15,000	June 25	July 29, 1895	Sept. 28, 1895	2,800	3,000
139	Corkscrew	....do	S. F. Toland and G. W. Langdon.	....do	Brush dam, bank of Spanish Ravine.	25,000	June 28	Works already built.	Sept. 2, 1895	3,937	5,000
140	Last Chance	Plumas	Henry Goering	....do	Log crib dam, outlet of Flat Basin.	10,000	July 1	....do	July 29, 1895	5,300	5,000
141	Chapelain Quartz.	Yuba	James Chapelain	....do	Brush dams in dry ravine emptying into Honcut Creek.	11,245,630	July 3	Oct. 14, 1895	....	....	....
142	Roome	Sierra	Luigi Lagomacini	Yuba	Brush dam across mouth of pit.	4,600	July 5	Works already built.	July 29, 1895	....	1,800
143	Big Ravine	Nevada	T. T. Kirkham	....do	Earth and gravel dam across old reservoir and brush dam on top of this and other dams.	6,000	July 6	Aug. 5, 1895	Dec. 7, 1896	....	6,000
144	Brown Placer	Sacramento	Interior Development Co.	Cosumnes	Brush and earth dam, flat ravine.	177,467	....do	July 29, 1895	....	....	....
145	Cascade	Plumas	Cascade Water and Manufacturing Co.	Feather	Log crib dam in Clear Creek.	774,400	July 10	Sept. 2, 1895	Dec. 2, 1895	....	400,000
146	Willow Placer	Sierra	N. B. Willits and B. Pride.	Yuba	Brush and timber dam across sweeping swale.	11,000	July 20	Works already built.	Sept. 2, 1895	8,462	10,000
147	Canada	....do	Oliver F. Caya and W. T. Sherman.	....do	Log crib dam, French Ravine.	12,444	July 26	Sept. 23, 1895	Nov. 18, 1895	42,500	50,000
148	King Sayre	....do	W. A. and H. E. Schofield.	....do	Brush and log dam, Whiskey Creek.	18,000	July 31	Works already built.	....do	1,200	8,000
149	Argentine	....do	Hy H. and A. A. Meyer and John Costa.	....do	Brush dam in a basin	4,000	Aug. 6	Sept. 23, 1895	Nov. 11, 1895	....	4,500
150	Eureka Hydraulic.	El Dorado	John Pascoe	American	Brush dams, Chili Ravine.	24,200	Aug. 7	Sept. 12, 1895	Sept. 30, 1895	3,400	5,000
151	Terry Hill	Plumas	E. C. Hard	Feather	Old pit stopped with stone dams.	7,480	Aug. 21	Works already built.	Oct. 14, 1895	2,286	4,850
152	Gravel Hill	El Dorado	E. D. Simpson, Gerhard Tebble, and J. A. Hunt.	American	Log dams, Gravel Hill Canyon, and natural barrier, Jones Hill Canyon.	387,000	Aug. 31	....	....	....	....
153	Lone Star Placer.	Plumas	Will De Vinny	Feather	Gravel dam and log dams, Jackson Creek.	18,488	....do	Works already built.	Oct. 14, 1895	21,190	20,000
154	Poor Man's Hydraulic.	El Dorado	Chas. Jordan	American	Two brush dams, Taylors Ravine.	3,023	Sept. 22	Oct. 15, 1895	Dec. 16, 1895	2,440	2,800

a Permit canceled April 5, 1897.

b Permit refused May 20, 1895.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1895.			*Cub. yds.*	*Cub. yds.*
155	Engle Mining Claim.	Amador	Lorenzo Canata and Giacomo Oneto.	Mokelumne	Brush dam, Dry Creek	10,300	Sept. 22	Works already built.	Nov. 4, 1895		
156	Jackson Creek Placer.	Plumas	Mrs. Bertha Sutton.	Feather	Old pits and dams, Jackson Creek.	32,000	Sept. 28	Nov. 19, 1895	Feb. 23, 1897		10,000
157	Bobby Burns Hydraulic.	El Dorado	Hy Niedecker and Geo. Alderson.	American	Brush dam, Johnsons Creek.	40,333	Oct. 1	Works already built.	Nov. 18, 1895		3,750
158	Dutch	Plumas	Simcoe Chapman	Yuba	Log crib dam in Rabbit Creek and old pit.	12,000	Oct. 3	do	do	35,700	30,000
159	Lewis	do	Fred Lewis	Feather	Dams in old pit and Rich Gulch.	1,000	Oct. 4	do	do		
160	Martin Hydraulic.	El Dorado	C. W. and W. W. Martin.	American	Dam, White Rock Canyon.	38,720	do	do	do	3,000	4,000
161	Miocene	Plumas	Chas. Y. Hepler	do	Dams, Schneider Gulch and old pit.	6,000	Oct. 8	Nov. 19, 1895	Mar. 30, 1896		1,025
162	Arctic	do	Fred Scott	Feather	Dam, Marian Creek.	18,000	do	do	Oct. 26, 1896		
163	Tiedeman	El Dorado	Henry E. Picket	American	Brush dam, Marshall Canyon.	129,055	Oct. 11	Works already built.	Nov. 18, 1895		
164	Chaparral Hill Gold Gravel.	Plumas	Ed and Jas. Bryan and August Fist.	Feather.	Brush and rock dam in dry ravine.	28,233	Oct. 12	Nov. 19, 1895	Dec. 16, 1895	1,000	32,333
165	Blacklock	El Dorado	Eugene Piaggi	American	Dams in Taylor and another ravine.	413,000	Oct. 19	Works already built.	Nov. 18, 1895	3,780	31,220
166	Pacific	Sierra	Daniel Conlan	Yuba	Old pits; cuts stopped with dams.	4,629	do	do	do		5,610
167	Plumas Blue Gravel.	Plumas	Plumas Blue Gravel Mining Co.	Feather	Old hydraulic pits	44,444	do	Nov. 19, 1895	Dec. 30, 1895	400	500
168	Reese	Shasta	George Reese	Sacramento	Brush dam in a dry ravine.	500,133	Oct. 21	Nov. 26, 1895	Jan. 6, 1896	1,000	1,000
169	Ram Creek Placer.	Butte	J. M. McClung	Feather			do				
170	Consolidated Sailor Creek Placer.	El Dorado	George W. Davey	American	Log, brush, and rock dam, Irish Creek.	14,520	Oct. 25	Works already built.	Nov. 18, 1895	2,004	500
171	Michigan Hill	Plumas	John Higgins	Feather	Two old pits stopped with brush dams and log dam on flat ground.	15,000	Oct. 29	Nov. 19, 1895	Dec. 2, 1895	3,620	3,000

172	Manzanita	Nevada	Kate Hayes Mining Co.	Yuba	Gravel and brush dams, Sweetland Creek.	1,159,604	Sept. 23	Oct. 7, 1895	Oct. 28, 1895	184,900	....
173	Farrel	....do	Eureka Lake and Yuba Canal Co.	....do	Earth dam in worked-out pit.	111,000	Oct. 28	Works already built.	Nov. 18, 1895	54,573	164,000
174	Forest Home	Amador	W. A. Roberts and Jno. Graham.	Cosumnes	Earth and stone dam, Arkansas Creek.	1,420,000	Nov. 2	....do	Dec. 23, 1895	93,000	90,000
175	Bull Neck Gravel.	....do	James F. Ish	San Joaquin	Log and brush dams in blind ravine.	200,000	Nov. 8	Dec. 24, 1895	....	....	50,000
176	Cole	El Dorado	W. H. Cole	Cosumnes	Brush dam in a dry gulch.	12,000	Nov. 16	Works already built.	Dec. 23, 1895	240	13,000
177	Mill Gulch Gravel.	Amador	Hy. M. & H. N., jr., Dickerman, and John Dynam.	....do	....do	900	Nov. 19	Dec. 24, 1895	Mar. 30, 1896	....	....
178	Jay Bird	Yuba	John G. Ramm	Yuba	Rock dam	12,100	Nov. 23	....do	Jan. 20, 1896	3,450	800
179	Wild Yankee	Placer	Wm. Schillinsky, C. A. Oakes, R. W. Walter, and S. L. McKim.	....	Timber dam	100,000	Nov. 25	Dec. 16, 1895	Dec. 21, 1896	2,900	3,000
180	Badger Hill	Plumas	A. B. Jacks and John Gifford.	Feather	Dam, Woods Ravine and closed cuts.	15,000	Nov. 27	Dec. 23, 1895	Jan. 13, 1896	2,935	3,000
181	Pine Leaf	....do	John Schafer	....do	Brush dam, worked-out pits.	4,000	Nov. 29	Works already built.	Dec. 23, 1895	140	650
182	Quaker Hill	Nevada	Geo. C. Sargeant	Yuba	Dams on flat ground, Deer Creek.	70,000	Nov. 30	....do	Dec. 30, 1895	....	244,000
183	Meehan Placer	Amador	Jas. Meehan	Sacramento	....	217,800	Dec. 3	Dec. 24, 1895	Mar. 30, 1896	997	1,000
184	Trafton	Placer	J. N. Findley	American	....	4,000	....do	Dec. 16, 1895	....do	82	4,000
185	Irish Hill	Amador	G. W. Smith	Mokelumne	Brush dam in a dry gulch.	322,667	Dec. 5	Works already built.	Dec. 23, 1895	....	....
186	Kerr	Placer	Jos. G. DeBons	American	Brush barriers, Devils Canyon.	2,000	Dec. 6	Jan. 13, 1896	Mar. 30, 1896	60	2,140
187	Clay Bank	Plumas	Henry A. Hallstead.	Feather	Log and brush barriers in flat swale.	6,500	Dec. 14	Works already built.	Jan. 13, 1896	2,500	3,500
188	Sherwood and Snyder.	Tuolumne	L. M. Sherwood, W. H. Snyder, and O. E. E. Ryley.	Tuolumne	Worked-out bed of Moccasin Creek.	75,000	....do	No works necessary.	....do	....	....
189	Blue Gravel Placer.	Amador	W. H. Glenn and J. H. Hayden.	Mokelumne	Brush dam, Rancheria Creek.	10,000	Dec. 23	Works already built.	....do	6,455	7,000
190	Emma Harding	Plumas	J. F. Evans	Feather	No works necessary	2,500	....do	No works necessary.	....do	....	....
191	Roman	....do	John Smith	....do	....do	....	....do	....do	....do	....	....
192	Kendall	El Dorado	Wiley Sexton	Cosumnes	Dogtown Creek	100	Dec. 26	Sept. 21, 1896	Dec. 21, 1896	....	....
193	Polar Star	Placer	John Spaulding	Feather	Bear River	2,000,000	Dec. 31 1896.	June 6, 1896.	....	....	....
194	Liberty Hill	Nevada	T. G. Phelps	....do	....do	144,000	Jan. 2	....do	....	....	....
195	Adkins	Shasta	Olonzo Engle	....	Brush dams in a gulch	161,334	Jan. 2	Works already built.	Jan. 20, 1896	....	....
196	Quong Yuck [b]	Nevada	On Sackee and Ah You.	Yuba	Log dam, Humbug Creek	75,000	Jan. 4	....	....	....	....

[a] Permit canceled January 19, 1897.

[b] Mine will not be worked.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1896.			*Cub. yds.*	*Cub. yds.*
197	Kanaka Flat	Plumas	Wm. Wampler and Solon P. Jacks.	Feather	Log dams in ravine and Spanish Creek.	6,000	Jan. 7	No works necessary.	Jan. 20, 1896	722	800
198	Coney	Shasta	G. M. Coney and W. S. Adkins.	Sacramento	Brush dams	150.000	Jan. 10		Mar. 17, 1896	5,624	6,000
199	Gorman	Placer	H. L. Van Eman	American	Log and brush dams, Skunk Gulch.	160,000	Jan. 13	Mar. 18, 1896	Mar. 30, 1896		
200	Princess	Shasta	O. H. Simons	Sacramento	Crib dam in dry gulch	4,114,000	Jan. 16	do	do	15,700	18,000
201	Goyan	El Dorado	Frank Goyan	American	Brush dam, Fish Canyon.	3,484,800	Jan. 7	Jan. 20, 1896			
202	Nigger Ranch	do	Giacomo Gianini and J. L. Poggi.	Cosumnes	Log dam	3,000	Jan. 22	Feb. 10, 1896	Dec. 21, 1896	195	3,805
203	Proper	Calaveras	John Sybel	Stanislaus		14,000	do	No works necessary.	Mar. 17, 1896	1,510	3,600
204	No Chunk	Placer	E. S. Thompson and G. E. Hill.	American	Log dam in Skunk Gulch.		do	Mar. 18, 1896	Mar. 30, 1896	500	600
205	Kanaka Valley	El Dorado	A. J. McDonald	do	Brush and rock dam	900	Jan. 28	Sept. 21, 1896			8,000
206	Empire Hill	Yuba	Paris Bean	Yuba	Board and log dam	1,700	Feb. 3				
207	Badger Hill	El Dorado	John J. Bailey	American	Pine tree dam	52,266	Feb. 17				
208	Dark Ravine	Plumas	Mrs. Amalie Hafner.	Feather	Log and brush dams in Dark Ravine.	1,000	Feb. 20	Oct. 27, 1896			600
209	Grasshopper Hydraulic.	El Dorado	B. Guidici	Cosumnes	2 brush dams	20,000	do	Apr. 20, 1896			20,740
210	Miner's Row	Placer	E. D. Hurd	American	Brush and log dams	48,400	Feb. 24	Apr. 6, 1896			
211	Nellie Bly	Shasta	Alfred A. Ludwig and Wm. Everest.	Sacramento	Log and brush dam	6,453	Mar. 17	Works already built.	Apr. 6, 1896	140	1,200
212	Duquesne Placer.	Plumas	R. R. Gumbert	Feather	Log and brush dam in dry ravine.	3,000	Mar. 19	Oct. 27, 1896			1,100
213	Try Again Hydraulic.	El Dorado	Giacomo Varrozza.	American	Brush dam	4,500	Mar. 23	July 13, 1896	July 20, 1896		
214	Ellen Taylor	do	Cy Mulkey	Cosumnes	Log and brush dam	1,209,967	Apr. 4	Works already built.	July 27, 1896	1,000	1,500,000
215	Phillips Claim	Placer	Wm. Phillips	American	Three brush dams	5,000	Apr. 7	July 20, 1896	Aug. 17, 1896	290	500
216	Cook Gravel	Tuolumne	F. W. Eaton	Tuolumne	None	900,000	Apr. 14	July 27, 1896			
217	Raffetto Placer	El Dorado	Giovanni Raffetto.	American	Brush and timber dams	67,000	Apr. 16	Works already built.	July 20, 1896	4,080	5,000
218	Parke and Browne Claim.	Placer	Bernard Cavanaugh.	do	Two log dams in dry ravine.	38,720	May 18	Aug. 18, 1896			

219	Deer Creek......	Nevada.......	Eber A. Sanford..	Yuba.........	None...................	48,400	May 18	No works necessary.	Nov. 2, 1896	....	....
220	Slate Creek Places. *b*	Plumas.......	Henry W. Orr....	Feather.......	Two log and brush dams.	4,000	June 3	....	....	....	....
221	Buckeye Hill Placer.	El Dorado.....	John J. Flora.....	American.....	Dam in Buckeye Canyon and flat ground.	2,000,000	June 6	Nov. 6, 1896	Apr. 26, 1897	....	....
222	California Gold Mining and Investment Co.'s Claim.	Plumas.......	California Gold Mining and Investment Co.	Feather.......	Brush dam, Foreman Canyon.	30,000	June 8	No works necessary.	Oct. 26, 1896	....	....
223	Shirley Mining Co.'s.	Placer........	Shirley Mining Co.	American.....	Two brush dams.........	3,780,000	June 15	Aug. 18, 1896	Jan. 11, 1897	1,000	3,000
224	Maylone Gravel.	El Dorado.....	J. R. Vandergrift.	Cosumnes....	None...................	....	June 25	Sept. 21, 1896	June 2, 1897	....	....
225	Jack's Ranch Placer.	Plumas.......	Walter Shackelford.	Feather.......	Log and brush dam......	....	July 20	Works already built.	Nov. 2, 1896	....	....
226	Sacket's Gulch Claim.	Sierra........	J. F. Cowdery.....	Yuba.........	Three crib log dams.....	27,000	July 25	.....do........	Nov. 16, 1896	4,440	5,243
227	Marlow.........	Tuolumne....	A. P. Scheld......	Tuolumne....	Brush and rock dam.....	4,000,000	May 1	July 27, 1896	July 27, 1896	7,800	8,000
228	Last Chance....	Plumas.......	Fred C. De Chaine.	Feather.......	No impounding works necessary.	30,000	June 11	No works necessary.	Oct. 26, 1896	....	....
229	Barnhardt......	Calaveras.....	Cadematori & Peirano.	Calaveras.....	Brush and rock dam.....	4,356,000	Aug. 5	Aug. 31, 1896..	Mar. 1, 1897	13,659	4,386,341
230	Beattie & Parsons. *b*	El Dorado.....	Geo. Beattie......	American.....	....	....	Aug. 7	....	....	....	....
231	Hilda..........	Sierra........	Richard Phelan...	North Yuba..	Log and brush dam......	....	Aug. 13	Oct. 27, 1896..	....	....	....
232	Alcyone........	Calaveras.....	W. A. Keefer.....	Calaveras.....	Dam in San Domingo Creek.	....	Aug. 21	Sept. 15, 1896..	Jan. 4, 1897	8,000	10,000
233	French Claim...	El Dorado.....	J. R. Sears.......	Middle Cosumnes.	Log and brush dam......	250,000	Aug. 25	Sept. 22, 1896..	Dec. 21, 1896	....	....
234	Larsen Placer..	.....do........	Emil E. Larsen and John H. Harris.	American.....	Log dam................	11,666	Aug. 28	Oct. 13, 1896...	Jan. 19, 1897	1,769	13,882
235	Miocene.......	Plumas.......	W. H. Leek.......	North Feather	Dam in Rush Creek.....	12,100	Aug. 31	Works already built.	Oct. 26, 1896	7,700	8,000
236	Cascajo........	Calaveras.....	Hugh Craig.......	Middle Mokelumne.	Brush dam..............	3,872,000	Sept. 3	Oct. 13, 1896..	....	....	....
237	Mad Mule......	Shasta........	John Faubel......	Sacramento...	On bank of Whiskey Creek.	200,000	...do....	Sept. 28, 1896..	Nov. 30, 1896	....	....
238	Blue Eyes......	Placer........	A. F. Sheehan.....	Middle American.	Log dam................	....	Sept. 11	Nov. 23, 1896..	....	....	....
239	Bell & Dorsey...	El Dorado.....	Plymouth Consolidated Gold Mining Co.	Cosumnes....	Log and brush dam......	....	Sept. 16	.....do........	....	....	....
240	Gold Run.......	Placer........	E. A. Wiltsee.....	North American.	Log crib dam...........	311,000	Sept. 2	Oct. 13, 1896...	Nov. 23, 1896	125,000	300,000
241	Craycroft.......	Sierra........	H. Spaulding and others.	Yuba.........	.....do................	90,000	Sept. 24	Oct. 27, 1896...	....	....	....
242	Clarke & Willis.	Calaveras.....	F. B. Clark........	South Mokelumne.	Log and brush dam......	60,000	Sept. 28	Nov. 17, 1896..	....	....	....

a Mine will not be worked.

b Will not be worked. No impounding facilities exist.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1896.			*Cub. yds.*	*Cub. yds.*
243	Albright Placer	El Dorado	W. H. Albright	American	Log and brush dam	4,833	Sept. 30	Works already built.	Nov. 9, 1896	1,120	2,000
244	Wild Cat	Nevada	Geo. W. Jones	South Yuba	Brush dam in Blind Shady Creek.	20,000	Sept. 30	do	Nov. 2, 1896	5,586	
245	Burlington	Sierra	John Freeman	North Yuba	Log and brush dam	20,000	Oct. 2	do	Oct. 26, 1896	1,244	
246	Little Bowlder Creek.	Plumas	Isaac Blomquist	Middle Feather	do	6,000	Oct. 7	do	do		
247	Eckman & Moulton.	Nevada	W. E. Moulton and D. W. Eckman.	South Yuba	Gravel and brush dam	177,000	Oct. 9	Nov. 2, 1896	Jan. 25, 1897	50,285	
248	Hall & French	do	Thos. Hall and Chas. D. French.	do	do	208,000	do	do	do	47,600	
249	Linda Placer	Sierra	David Corbett	North Yuba	Two dams on flat	12,500	do	Works already built.	Nov. 16, 1896		
250	Divide	El Dorado	Jas. E. Roelke	South American.	Brush and rock dam	6,600	Sept. 14	do	Nov. 9, 1896	4	
251	Campi Placer	Amador	Eckhart & Solario	Mokelumne	Log and brush dam	9,000	Sept. 17	do	Dec. 28, 1896	4,000	
252	Blackwater Claim.	Plumas	Wm. Konradi	Feather	Works of Gopher Hill mine in Waupansie Creek.	30,000	Oct. 20	do	Nov. 16, 1896	7,607	
253	Santa Clara	Amador	Em. Santirfo	Mokelumne	Log and brush dam		Oct. 21	do	Dec. 28, 1896	672	
254	Cleveland Placer	Plumas	Pitro Picolo and Luigi Sobrero.	Middle Feather	do	30,000	do	do	Nov. 16, 1896		
255	Lady Edner	El Dorado	Chas. Edner	Middle Cosumnes.	Brush dam	1,873	Oct. 24	Nov. 9, 1896	Dec. 21, 1896	1,600	
256	Grub Flat, No. 2	Plumas	Walter Shackleford.	North Feather	Log and brush dam	25,000	Oct. 26	Works already built.	Nov. 16, 1896	2,100	
257	Sebastopol Flat	do	Francis Jackson	do	Rock and brush dam	6,000	do	do	do	424	
258	Preacher's Ravine.	Sierra	Lamont Brown	Yuba	Log and brush dam	11,111	Oct. 22	Nov. 16, 1896			
259	Crawford Diggings.	Yuba	J. H. Nickleson and T. J. Williams.	North Yuba	do	20,000	Nov. 7	Works already built.	Dec. 7, 1896	1,000	
260	Forty Nine	Butte	Oregon Gold Mining Co.	South Feather	Brush dam		do	Dec. 7, 1896	Jan. 19, 1897	200	
261	Bald Mountain Gravel.	El Dorado	Edgar Maylone	Cosumnes	Log and brush dam	2,772	do	Works already built.	Dec. 21, 1896	15,180	
262	Gilbert	Placer	Hoffman & McDonald.	North American.	do	6,200	Nov. 9	do	Dec. 7, 1896		

263	Buckeye Hill	Nevada	Geo. W. Jones	Feather	do	10,000	Nov. 24	Dec. 7, 1896	Jan. 25, 1897	372	
264	North Star	El Dorado	C. W. and W. W. Martin.	South American.	Brush dam		Nov. 28	Works already built.	Dec. 21, 1896	16,800	
265	Bowlder Hill	do	Stevens, McKinney & Co.	do	Brush and rock dam		Nov. 30	do	do	870	
266	Hayden Hill	Placer	Ah Sing	North American.	Rock dam		do	Dec. 21, 1896	Dec. 28, 1896	12,200	
267	Union *a*	Yuba	C. C. Beever	Yuba	Brush dam in dry ravine		Dec. 4	Jan. 5, 1897		92	
268	Golden Gate	Plumas	W. H. Trescott	Feather			Dec. 5				
269	Saxton	do	Dr. C. P. Saxton	do	No impounding works necessary.		do	No works necessary.	Jan. 4, 1897	125	
270	Sailor Flat	Nevada	O. D. Campbell	South Yuba	Log and brush dam	25,000	Dec. 7				
271	Blue Tent	do	W. H. De Mott	do	do	60,000	do	Works already built.	Jan. 25, 1897	7,500	
272	Frank Milan	Yuba	Mathias Diehl	North Yuba	Rock and brush dam		do	Jan. 5, 1897	Feb. 8, 1897	650	
273	Montre	Sierra	R. M. Cunningham and Thomas Phillips.	Yuba	Brush dam in Grizzly Canyon.		Dec. 12	Works already built.	Jan. 25, 1897	3,000	
274	Belle Quartz *b*	Plumas	Frank E. Thomas	North Feather	Log and brush dam		Dec. 14				
275	Cedar Creek Consolidated.	El Dorado	Cy Mulkey	Cosumnes	do		Dec. 16	Jan. 5, 1897			
276	Lucot	Amador	Samuel D. Robinson and Al Petty	do	do		Dec. 28	Works already built.	Jan. 4, 1897	2,000	
							1897.				
277	Drummondsville	do	S. J. Holsinger	Cosumnes	Brush dam		Jan. 5	Jan. 25, 1897	Mar. 22, 1897	600	
278	Pebble bottom	Placer	G. D. Duncan & Co.	North American.	Log and brush dam	33,333	Jan. 7	do	Feb. 8, 1897	350	
279	Woodpecker Placer.	Butte	D. Edgmon	South Feather	Brush dam	15,000	Jan. 8	Works already built.	Feb. 1, 1897	2,045	
280	Big Chunk	El Dorado	John C. Murphy	South American.	Log and brush dam	2,420	Jan. 9	do	do	120	
281	Hawkeye	Amador	Henry Whitehead & Co.	Mokelumne	Brush dam	17,000	Jan. 20	do	do	528	
282	Irish Hill	do	Geo. W. Hadley	Cosumnes	do		Jan. 18	do	do	1,150	
283	Frazer Placer	Calaveras	J. B. Leonardini	Calaveras	Brush dam in Old Gulch		Jan. 28	Feb. 15, 1897	Mar. 1, 1897	702	
284	Zugar & Lewis	do	J. W. Zugar	do	do		do	do	do	2,608	
285	High Point	Yuba	Thos. Mullin	Middle Yuba	Log and brush dam		do	do			
286	Kentucky Hill	Sierra	Chas. Weiss	do	do		do	do	Mar. 29, 1897	1,100	
287	Roberts & Co.'s	Yuba	A. F. Roberts	Yuba	Rock and earth dam	1,700	Feb. 1	Works already built.	Feb. 15, 1897	550	
288	Sugar Loaf	Placer	Ed. Gray and John Taylor.	South Yuba			Feb. 2	do	do	475	
289	Smith's Flat	Plumas	Wampler & Jacks	Feather	Log and brush dam	5,000	Feb. 10				
290	Sunny South	El Dorado	E. Williamson & Co.	Middle Cosumnes.	do	150,000	Feb. 17	Works already built.	Mar. 8, 1897	7,628	
291	Jones & Humphreys. *c*	Yuba	Dave Humphreys and R. R. Jones.	North Yuba	do		Feb. 19				
292	Hall's Flat	Butte	B. P. Crandall	North Feather			Feb. 12	Feb. 23, 1897	Mar. 1, 1897	396	
293	Annie Laurie	Placer	Geo. Nissen	North American.	Brush and rock dam	15,000	Mar. 9	Mar. 29, 1897			

a Working under permit of November 27, 1894.

b Not being a natural bank is not within the jurisdiction of the Commission.

c Mine abandoned.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1897.	Storage capacity yet available partly or wholly completed.
						Cub. yds.	1897.			Cub. yds.	Cub. yds.
294	Alameda	Placer	Frank Wise and Martin Partridge.	North American.	Brush and rock dam	50,000	Mar. 9	Works already built.	Mar. 29, 1897	1,800	
295	Philadelphia	Tuolumne	T. C. Cox and A. C. Pidge.	Stanislaus	Log and brush dam	31,600,000	Mar. 13				
296	Little Grass Valley.	Nevada	F. G. Curnow et al.	Yuba	Rock and brush dam	3,000	Mar. 29	Works already built.	Apr. 19, 1897		
297	Galena Hill [a]	Yuba	Morris J. Williams et al.	do	Brush dams	3,000	Apr. 6	do	May 3, 1897		
298	Hustler No. 2 [b]	Nevada	Jos. Hustler	do	do	9,000	Apr. 12				
299	Howlett	do	Charles and Ben Howlett.	do	Log and brush dam	10,000	Apr. 19	May 10, 1897			
300	Marguerite	Butte	Marguerite Gold Quartz Mining Co.	do	do	15,000	Apr. 21				
301	McGregor & Nix [c].	do	Wm. McGregor and C. F. Nix.	Sacramento	Impounding works of Spring Valley Mine.		Apr. 23				
302	Industrial	El Dorado	Industrial Gold Mine Co.	Cosumnes	Log and brush dam	1,500	May 3	Works already built.	May 24, 1897		1,500
303	Messerer	Plumas	James Rooks	Feather	do	1,000	May 5				
304	Costa & Davis Mining Co.'s.	Butte	John Costa and Frank Davis.		Worked-out pit	10,000	May 8	May 24, 1897			
305	Haskel Ravine	Sierra	Haskel Ravine Mining Co.	Feather	Log and brush dam	14,000	May 11				
306	Parsons	El Dorado	Hoey & Lewis	Cosumnes	do	200,000	May 22	June 14, 1897			
307	Morristown	Sierra	Daniel McLaughlin.	Yuba	do	10,000	May 24				
308	Etta	do	Henry Northrop and Robert C. Nicholson.	do	Log and rock dam	444	May 26				
309	May Flower	Placer	May Flower Gravel Mining Co.	American		4,000,000	May 28				
310	Pactolian	Plumas	Dr. J. P. Welch	Feather	Log and brush dam	64,500	June 1				
311	Mountain View	Butte	J. P. West	do	Brush dam		May 26	June 28, 1897			

[a] Supplemental application.

[b] Authorization of proposed impounding works disapproved May 8, 1897.

[c] Permit refused.

APPENDIX B.

CHAPTER CXIII.

AN ACT to amend an act entitled "An act to provide for the appointment, duties, and compensation of a Débris Commissioner, and to make an appropriation to be expended under his directions in the discharge of his duties as such commissioner," approved March 24, 1893.

The people of the State of California, represented in senate and assembly, do enact as follows:

SECTION 1. Section one of the act entitled "An act to provide for the appointment, duties, and compensation of a Débris Commissioner, and to make an appropriation to be expended under his directions in the discharge of his duties as such commissioner," approved March twenty-fourth, one thousand eight hundred and ninety-three, is hereby amended so as to read as follows:

"SECTION 1. The Governor of the State of California shall, on or before the first day of January, one thousand eight hundred and ninety-eight, appoint a competent civil engineer, for a period of four years only, to be known as and called the Débris Commissioner: *Provided, however,* That the Débris Commissioner heretofore appointed under the act entitled 'An act to provide for the appointment, duties, and compensation of a Débris Commissioner, and to make an appropriation to be expended under his directions in the discharge of his duties as such commissioner,' approved March twenty-fourth, eighteen hundred and ninety-three, shall continue to perform the duties and receive the compensation of that office, subject to the provisions of this act, until the expiration of the term for which he was appointed and until the appointment and qualification of the Débris Commissioner provided for by this act."

SEC. 2. Section two of said act is hereby amended so as to read as follows:

"SECTION 2. Said commissioner shall receive a compensation of ten dollars per day while actually engaged in the discharge of his duties, and his necessary traveling expenses, to be allowed by the State Board of Examiners."

SEC. 3. Section three of said act is hereby amended so as to read as follows:

"SECTION 3. It shall be the duty of the said Débris Commissioner to consult and advise with the members of the corps of engineers of the United States Army comprising the California Débris Commission (created by act of Congress approved March first, eighteen hundred and ninety-three), in relation to the construction of works for the restraining and impounding of débris resulting from mining operations, natural erosion, or other causes; and it shall be his duty to examine such works, and to report the result of such examination to the State Board of Examiners. Said Débris Commissioner is further authorized and directed to consult and advise with said 'California Débris Commission' in relation to any and all plans and specifications that may have been or may hereafter be prepared or adopted by said 'California Débris Commission' for the construction of such restraining or impounding works, and said Débris Commissioner shall submit a copy of all such plans and specifications to the State Board of Examiners for their examination and consideration, together with his approval or disapproval thereof, or other recommendation with reference thereto.

"The State Board of Examiners shall thereupon proceed to examine and consider the plans and specifications thus submitted to them, and in that behalf may require the attendance, counsel, and advice of said Débris Commissioner during their examination and consideration thereof. The State Board of Examiners shall keep a record of their deliberations, and shall either approve or disapprove said plans and specifications, which approval or disapproval may be by a majority vote of said board: *Provided,* That no plans and specifications involving an expenditure on the part of the State of California of a sum greater than the appropriation herein made shall be approved.

"If said plans and specifications be approved by the State board of examiners, the said Débris Commissioner shall thereupon report such action to said 'California Débris Commission.'

"Whenever said 'California Débris Commission' or the Government of the United States shall have entered into any contract for the construction of works for the purposes described in this act, in pursuance of plans and specifications that have been theretofore approved by the State board of examiners as in this act provided, it shall then be the duty of the Débris Commissioner to carefully inspect such works during the process of their construction, and to keep a record of the result of such inspection, and to report the same monthly to the State board of examiners. Said Débris Commissioner shall also, from time to time, during the process of the construction of such works, when requested so to do by the said 'California Débris Commission,' draw his warrants upon the State controller in favor of such person or persons as may be designated by said 'California Débris Commission' for such amounts as shall equal one-half of the cost of the construction of said works; and said Débris Commissioner shall, in like manner, and when requested so to do by said

'California Débris Commission,' draw his warrant upon the State controller for an amount equal to one-half the purchase price of any site or sites necessary for the construction of said works: *Provided*, That the purchase of such site or sites shall have been first approved by the State board of examiners: *And provided further*, That no warrant shall be drawn in excess of the amount appropriated by this act."

SEC. 4. Section four of said act is hereby amended so as to read as follows:

"SECTION 4. There is hereby appropriated, out of the general fund of the treasury of this State not otherwise appropriated, the sum of two hundred and fifty thousand dollars, to be used in the construction of works for the restraining and impounding of débris resulting from mining operations, natural erosion, or other causes, and for the purpose of sites therefor. The appropriation made by this section is intended as a reappropriation of the sum of two hundred and fifty thousand dollars appropriated by the act entitled 'An act to provide for the appointment, duties, and compensation of a Débris Commissioner, and to make an appropriation to be expended under his directions in the discharge of his duties as such Commissioner,' approved March twenty-fourth, eighteen hundred and ninety-three; and it is expressly intended and provided by this act that the State of California shall in no event incur any liability hereunder beyond the amount of the appropriation herein made; and no contractor, claimant, or person shall acquire any right or obligation against the State of California beyond said sum so appropriated and set apart for the purposes hereinabove set forth; and it is expressly declared that any claim or demand against the State of California in excess of said appropriation shall be invalid and void. Said moneys shall be paid only upon orders drawn by the State controller upon the written request of said Débris Commissioner, as in the act provided.

SEC. 5. Section seven of said act is hereby amended so as to read as follows:

"SECTION 7. All expenditures authorized by the provisions of this act shall be subject to the approval of the State board of examiners; and the State controller is hereby authorized to draw his warrant for all expenditures not in excess of the appropriation herein provided for so approved by the State board of examiners, and the State treasurer is hereby directed to pay the same."

SEC. 6. This act shall take effect immediately.

SEC. 7. This act shall take effect immediately.

Approved, March 17, 1897.

APPENDIX Y Y.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

[Reported under section 2, river and harbor act of 1884, and section 4, river and harbor act of 1886.]

1. Report of Lieut. Col. Chas. J. Allen, Corps of Engineers.
2. Report of Maj. J. H. Willard, Corps of Engineers.
3. Report of Capt. Dan C. Kingman, Corps of Engineers.
4. Report of Maj. James F. Gregory, Corps of Engineers.
5. Report of Capt. Geo. A. Zinn, Corps of Engineers.
6. Report of Lieut. Col. G. J. Lydecker, Corps of Engineers.
7. Report of Maj. W. S. Stanton, Corps of Engineers.

(1) REPORT OF LIEUT. COL. CHAS. J. ALLEN, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 20, 1897.

GENERAL: In accordance with General Orders No. 6, June 1, 1887, and General Orders No. 9, June 26, 1888, Headquarters Corps of Engineers, Washington, I have the honor to submit the following report of all cases in which piers, breakwaters, locks, and dams, or other structures or works built or made by the United States in aid of commerce or navigation in this district, are used, occupied, or injured by a corporation or an individual, and the extent and mode of such use, occupation, or injury.

OCCUPANCY OF THE POTOMAC FLATS, BELONGING TO THE WORKS OF IMPROVEMENT OF THE POTOMAC RIVER AT WASHINGTON, DISTRICT OF COLUMBIA.

Under date of January 28, 1897, the unauthorized use and occupation by certain persons of portions of the Potomac Flats was again reported to the United States attorney for the District of Columbia, in accordance with the provisions of section 11 of the river and harbor act of September 19, 1890. One of the parties so reported, a firm of lumber dealers, was given until July 1, 1897, to vacate the grounds occupied by them. * * *

No other occupation, or use of, or injury to works built in this district in aid of commerce or navigation has been reported to this office since the date of the last report upon the subject.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

(2) REPORT OF MAJ. J. H. WILLARD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., July 1, 1897.

GENERAL: In compliance with requirements of General Orders No. 9, Headquarters Corps of Engineers, series of 1888, I have the honor to report the following information obtained since my report for the fiscal year ending June 30, 1896, concerning the occupation of, trespass, or injury to public works in my charge, viz:

Under date of January 16, 1897, the Board of Trade of Vicksburg, Miss., reported that officers and agents of local packets and other steamboats coming to the city wharf complained of obstructions at mouth of Vicksburg harbor, consisting of shanty boats and other small water craft moored at that locality, which interrupted and made navigation dangerous, stating that they were informed the jurisdiction of the city did not cover the case, and asking action by United States authorities. In accordance with section 11 of river and harbor act of September 19, 1890, on February 10, 1897, I sent copy of this complaint to Mr. R. C. Lee, United States attorney for southern district of Mississippi, at Madison Station, Miss. * * *

By letter to the Secretary of War dated April 9, 1897, W. H. Wall made complaint that navigation of Bayou D'Arbonne, La., was obstructed by raftsmen tying lines across that stream catching floating timber, and thereby delaying the passage of steamboats. In accordance with your directions of April 24, 1897, by indorsement upon this letter, the matter was investigated by me; the information obtained was sent Mr. J. Ward Gurley, jr., United States attorney for eastern district of Louisiana, at New Orleans, La., May 5, 1897, and copies were sent you with my indorsement of same date upon original complaint. Under date of May 8, 1897, the papers were acknowledged by the district attorney, who stated that the matter would receive prompt attention.

Very respectfully, your obedient servant,

J. H. WILLARD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

(3) REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

[For letter of transmittal, see Appendix B B.]

No case of unlawful occupancy of public works has occurred in this district during the past year, and only trifling injuries have been done by individuals.

Upon the Upper Tennessee River and upon the French Broad River, particularly at Soddy Shoals on the former and Hanging Rock Shoals on the latter, individuals, perhaps fishermen, have made breaks in the training walls constructed by the United States, in order, it is supposed, to enable them to pass with their skiffs from one side of the river to the other without going around the ends of these walls. The injuries are not very serious, but they do draw off a portion of the water from the navigable chute, and to this extent interfere with navigation. It was believed that this mischief was done by people who were ignorant of the law. It was not possible to find out who the parties were, in order that they might be warned personally; but in order that the law might be generally known in the vicinity, notices were printed upon linen and posted in the vicinity of the breaks. The notices were as follows:

NOTICE.

$5,000 FINE AND ONE YEAR IMPRISONMENT.

All persons are hereby warned not to alter, deface, injure, obstruct, or in any manner impair the usefulness of the works built by the United States for the improvement of this river.

The following is the law:

"SECTION 9. That it shall not be lawful for any person or persons to take possession of, or make use for any exclusive purpose, or build upon, alter, deface, destroy, injure, obstruct, or in any other manner impair the usefulness of, any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States, in whole or in part, for the preservation and improvement of any of its navigable waters, or to prevent floods, or as boundary marks, tide gauges, surveying stations, buoys, or other established marks, nor remove for ballast or other purposes any stone or other material composing such works.

"SECTION 10. * * * Any person or persons who shall violate the provisions of this act, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding $5,000 or by imprisonment not exceeding one year, or by both such punishments."

DAN C. KINGMAN,
Captain of Engineers in Charge.

It is thought that when the people are aware of the serious penalty which the law imposes they will refrain from further interference with these works.

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(4) REPORT OF MAJ. JAMES F. GREGORY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, July 21, 1897.

GENERAL: I have the honor to submit the following report of information obtained during the fiscal year ending June 30, 1887, with reference to occupancy of and injury to public works in my charge at the close of the fiscal year ending June 30, 1897:

GREAT KANAWHA RIVER, WEST VIRGINIA.

In lowering the movable dam at Lock No. 7 on the night of November 28, 1896, a sudden rise in Coal River, which latter empties into the Great Kanawha about 1¼ miles above No. 7, brought out a large quantity of heavy drift. The lockmen, misjudging the extent of the rise, delayed too long about lowering the wickets of the navigation pass of the dam, and so much drift accumulated against the pass trestles that nine of them could not be put down. Some of the drift was removed and the trestles put part way down by December 1. On December 3, the river having fallen some, the fouled trestles were pulled up, with five others near the lock, to clear out the drift and lower the trestles. While this work was in progress the towboat *Winifrede* came down with three loaded coal barges. The towboat started to land at the head of the lock, to be locked through, but before her lines were secured the strong current around the head of the river wall of the lock and through the pass swung the steamer out from the shore. The towboat was unable to hold the tow, and the towboat and tow were carried down against the standing trestles. Twelve of the trestles were bent and broken, some of them being badly wrecked; also, twelve bridge aprons were bent or broken, four rails were injured, and five rails were lost in the river. One of the coal barges was sunk alongshore below the dam, out of the way of navigation, and another barge was considerably damaged by striking the trestles.

The owner of the *Winifrede*, one of the most careful and skillful towboatmen on the river, was at the wheel at the time of the accident. As the conditions and circumstances were almost unprecedented at the time of the accident, it appeared that no one was to blame for it, and no action against the owner or officers of the towboat was recommended.

With the exception of the Kanawha Lumber and Manufacturing Company, operating a small sawmill about 1 mile above Lock No. 7, the mills have, so far as known, complied with the law in regard to disposition of refuse. The mill of the Kanawha Lumber and Manufacturing Company was idle a considerable part of the past year. It has started up again recently, and part of the sawdust and edgings has been thrown over the bank. A fire is kept going to burn this stuff, but in the absence of a furnace or other suitable inclosure more or less of it is not consumed, and is left where it would be carried into the river by high water. The superintendent of the company was recently notified that he must change or better his arrangement for disposing of the refuse.

Very respectfully, your obedient servant,

JAMES F. GREGORY,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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(5) REPORT OF CAPT. GEO. A. ZINN, CORPS OF ENGINEERS.

[For letter of transmittal, see Appendix H H.]

AHNAPEE HARBOR, WISCONSIN.

Two hundred and eighty linear feet of the shore end of the south pier is occupied by Mr. Edward Decker. He has built a warehouse just in the rear of a portion of it and receives and ships goods over the pier, and claims the land upon which the pier is built.

KENOSHA HARBOR, WISCONSIN.

Some 400 feet of the shore end of the south pier is now used and has been occupied by Mr. George S. Baldwin as a coal and lumber dock since 1883.

The records are not clear as to the ownership of this portion of the pier, or whether it was originally built by the United States, by the city of Kenosha, or by private parties.

A portion of it is in bad condition. The best interests of the harbor require that it should be put in good order. It should therefore be rebuilt by occupant or vacated and rebuilt by the United States.

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(6) REPORT OF LIEUT. COL. G. J. LYDECKER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., September 4, 1897.

GENERAL: Pursuant to requirements contained in General Order No. 9, Headquarters Corps of Engineers, U. S. A., Washington, D. C., June 26, 1888, I have the honor to report that * * * on August 23, 1896, steamer *Avon* struck Fort Brady Pier, Sault Ste. Marie, Mich., doing damage to the amount of $142.08, which sum was recovered and deposited by John Power, United States district attorney, and credited to the appropriation for "operating and care of canals and other works of navigation, indefinite," allotment "St. Marys Falls Canal."

Very respectfully, your obedient servant,

G. J. LYDECKER,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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(7) REPORT OF MAJ. W. S. STANTON, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 21, 1897.

GENERAL: In compliance with General Orders, Headquarters Corps of Engineers, No. 6 of 1887 and 9 of 1888, I have the honor to report that the Northern Central Railroad Company has built a house upon that part of the west pier at the entrance to Great Sodus Bay, New York, which has been so covered by the accretion of sand that the upper timbers of the pier are just visible at the surface. The house is used as a dwelling or club house in summer. In December, 1895, I requested the company to remove it, but after a correspondence extending to April, 1896, the company failed to manifest any disposition to comply with the request, and on June 10, 1896, I presented the subject to the United States district attorney, Hon. W. A. Poucher, Oswego, N. Y.

Accretion of sand, to the extent of about 40 acres, has occurred along the west pier and in the angle between it and the shore, and fences built upon this accretion by the railroad company or others claiming the land interfere with the free passage of wagons along the pier to the lake to haul sand for building purposes, and this house prevents the use of the pier as a road for that purpose. If teams could get free access on the buried pier to the beach a very considerable quantity of sand would be hauled away for building which now drifts over the pier into the channel, from which it has to be dredged.

As fences have been built up to the pier upon the land formed by accretion, and as this house occupies the full width of the pier, the officers and employees of the United States, including the light-house keeper, can pass on the land along the pier or on the latter only by sufferance of those who have taken possession of the pier built by the United States at a cost of many thousand dollars, and of the land which it has formed.

* * * * * * *

During the year the steamer *C. Wall* and the schooner *Augusta* collided, the former against the light-house pier extension and the latter against the westerly shore return of the outer breakwater at Oswego, N. Y., but as it was not certain who, if any one, was to blame for the collisions, no steps were taken to collect the cost of repairs, which was small in both cases.

There is no other occupancy of piers in this district, and no other injury has occurred to them by collisions during the fiscal year ending June 30, 1897.

Very respectfully, your obedient servant,

W. S. STANTON,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

APPENDIX Z Z.

REPAIR OF THE AQUEDUCT BRIDGE ACROSS THE POTOMAC RIVER AT WASHINGTON, D. C.

REPORT OF LIEUT. COL. CHAS. J. ALLEN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 19, 1897.

GENERAL: I have the honor to forward herewith my annual report for the year ending June 30, 1897, for repairs to the Aqueduct Bridge, * * *.

Very respectfully, your obedient servant,

CHAS. J. ALLEN,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPAIR OF THE AQUEDUCT BRIDGE ACROSS THE POTOMAC RIVER AT WASHINGTON, D. C.

SKETCH OF THE WORK.

In compliance with a resolution of the United States Senate of January 21, 1893, an examination of the piers of the Aqueduct Bridge was made May 2 to 20, 1893, with the aid of a diver.

On June 21, 1893, a report in detail was made of the examination, and on July 17, 1893, an estimate of the cost of the repairs, amounting to $51,070, was submitted. It was proposed to repair Pier No. 4 by means of a cofferdam, within which the defective masonry was to be rebuilt, and to repair the remaining piers with Portland cement concrete in bags put in place by a diver. (Report of the Chief of Engineers for 1895, pp. 4085–4091.)

WORK DONE.

On August 7, 1894, an appropriation of $51,070 was made in the District of Columbia appropriation act for the fiscal year ending June 30, 1895, for the repair of the bridge, as follows:

> For the repair of the Aqueduct Bridge, fifty-one thousand and seventy dollars, said sum to be expended by, and the work to be done under, the direction of the Chief of Engineers of the Army, by contract or otherwise, and by the purchase of material in open market, in order to prevent delay in the prosecution of the work.

On September 29, 1894, a contract was entered into with the Shailer & Schniglau Company, of Chicago, Ill., for the repair of Piers Nos. 2, 3, 5, 6, 7, and 8 by Portland cement concrete in bags put in place by a diver, and for the repair of Pier No. 4 by means of a cofferdam within which new masonry was to be laid in the eroded cavity, the bridge spans resting on Pier No. 4 to be supported on false work during the repairs to provide against any possible further failure of the pier when the water was pumped out of the cofferdam and the effective weight of the overhanging masonry of the upstream end thereby increased.

After the cofferdam had been pumped out and débris disposed of, the overhanging masonry of the ice breaker was removed in order that the reconstruction of this part of the pier might be safely prosecuted. This masonry, which was just above the eroded cavity, was found to be well laid in lime mortar and was removed with some difficulty. The removal of the débris below the eroded cavity was next undertaken, the excavation being carried down to solid rock and as far downstream as the first line of cross braces of the original cofferdam of 1838, which timbers, 21 in number, had been left in place and built into the masonry of the pier. As this work went on, it was found that the old masonry had not been started from solid rock, and part of it was of poor quality.

The Acting Secretary of War and the Chief of Engineers made an inspection of the work on June 24, 1895, and in view of the poor quality of the masonry at the base of the pier it was decided that after the completion of the present contract (for the upstream end of the pier) it would be necessary in the near future to remove the defective masonry in the remainder of the pier and replace it by masonry of proper quality founded on the solid rock. The existing appropriation was insufficient for this purpose, and it was therefore necessary to ask a further appropriation from Congress. The cofferdam would be needed for the proposed work, and the contract was therefore modified June 27, 1895, so as to provide for the purchase of the cofferdam from the contractors for the sum of $3,000 in lieu of its removal by them, for which last they were to be paid $1,500 and were to have the timber.

The work of repairs under the appropriation of August 7, 1894, was completed in August, 1895. The total expenditure, including contract work, hired labor, purchase of materials and cofferdam, superintendence, inspection, etc., was $46,379.70, leaving a balance of $4,690.30, which reverted to the United States Treasury.

Full reports of the work of repairs to the bridge piers will be found in Appendix A A A to the annual reports of the Chief of Engineers for 1895 and 1896.

A complete report and estimate of the cost of reconstruction of pier No. 4 will be found in the report dated November 30, 1895, of the officer then in charge, and published as Document No. 158, House of Representatives, Fifty-fourth Congress, first session. The estimated cost of reconstruction of the pier was $65,000, which sum was appropriated as follows, by the act of Congress of June 8, 1896:

> Repairs to Aqueduct Bridge: For reconstruction of pier numbered four of the Aqueduct Bridge across the Potomac River at Georgetown, District of Columbia, to be available until expended, sixty-five thousand dollars.

A contract for the work of reconstruction of the pier was made May 17, 1897, with the Houston Construction Company, of Philadelphia, Pa. The contract was approved May 28, 1897. The work to be completed November 1, 1897. Amount of contract, $30,000.

The contractors commenced work on the 28th of May, and by the close of the fiscal year had most of their plant in position on the cofferdam; had made some progress in quarrying stone at their quarry, which is on the east bank of the Potomac, and about 3 miles above Georgetown; and had done some work toward putting in repair the false work for supporting the spans adjoining pier 4, and also the cofferdam.

Other work during the fiscal year ended June 30, 1897, consisted in some slight necessary repairs by hired labor to the cofferdam.

Amount expended during fiscal year ended June 30, 1897, $1,446.43.

Money statement.

Amount appropriated by act of June 8, 1896		$65,000.00
June 30, 1897, amount expended during fiscal year		1,446.43
July 1, 1897, balance unexpended		63,553.57
July 1, 1897, outstanding liabilities	$436.00	
July 1, 1897, amount covered by uncompleted contracts	30,000.00	
		30,436.00
July 1, 1897, balance available		33,117.57

Abstract of proposals for reconstruction of pier No. 4 of the Aqueduct Bridge, District of Columbia, opened by Lieut. Col. Chas. J. Allen, Corps of Engineers, March 22, 1897.

Material.	Estimated quantity.	Albert Weber, Baltimore, Md.		Clark & Co., New York, N. Y.		Houston Construction Co., Philadelphia, Pa.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Repair and maintenance, false work and cofferdam	*Cu. yds.*	$2,800.00	$2,800.00	$1,600.00	$1,600.00	$5,850.00	$5,850.00
Pumping out cofferdam		675.00	675.00	2,500.00	2,500.00	5,125.00	5,125.00
Removal of false work and cofferdam		6,000.00	6,000.00	7,500.00	7,500.00	3,000.00	3,000.00
Removal of old masonry	1,470	1.50	2,205.00	4.00	5,880.00	2.00	2,940.00
Excavation, etc	300	2.00	600.00	4.00	1,200.00	2.00	600.00
Concrete	210	6.55	1,375.50	12.00	2,520.00	8.00	1,680.00
Ashlar masonry	460	18.00	8,280.00	16.00	7,360.00	18.00	8,280.00
Header masonry	45	10.00	450.00	16.00	720.00	18.00	810.00
Rubble masonry	620	6.00	3,720.00	7.00	4,340.00	10.00	6,200.00
Removing and resetting coping	21	20.00	420.00	8.00	168.00	10.00	210.00
Repair of iron trusses		575.00	575.00	350.00	350.00	200.00	200.00
Total			27,100.50		34,138.00		34,895.00
Time of commencement		Apr. 15, 1897		June 1, 1897		Apr. 15, 1897.	
Time of completion		Mar. 15, 1898		Jan. 1, 1898		Sept. 1, 1897.	

Material.	Estimated quantity.	R. H. Hood, Washington, D. C.		Jutte & Foley Co., Pittsburg, Pa.		J. J. Shipman, Washington, D. C.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Repair and maintenance, false work and cofferdam	*Cu. yds.*	$2,100.00	$2,100.00	$10,000.00	$10,000.00	$1,000.00	$1,000.00
Pumping out cofferdam		3,200.00	3,200.00	3,000.00	3,000.00	2,500.00	2,500.00
Removal of false work and cofferdam		1,500.00	1,500.00	3,000.00	3,000.00	1,000.00	1,000.00
Removal of old masonry	1,470	5.00	7,350.00	1.50	2,205.00	14.00	20,580.00
Excavation, etc	300	3.00	900.00	3.00	900.00	14.00	4,200.00
Concrete	210	14.00	2,940.00	12.00	2,520.00	14.00	2,940.00
Ashlar masonry	460	37.00	17,020.00	21.50	9,890.00	14.00	6,440.00
Header masonry	45	40.00	1,800.00	21.50	967.50	14.00	630.00
Rubble masonry	620	12.00	7,440.00	21.50	13,330.00	14.00	8.680.00
Removing and resetting coping	21	15.00	315.00	21.50	451.50	28.00	588.00
Repair of iron trusses		224.00	224.00	500.00	500.00	200.00	200.00
Total			44,789.00		46,764.00		48,758.00
Time of commencement		May 1, 1897		Apr. 10, 1897		Apr. 1, 1897.	
Time of completion		Nov. 30, 1897		Oct. 1, 1897		Nov. 1, 1897.	

All the above proposals were rejected and the work was readvertised under date of April 10, 1897.

Abstract of proposals for reconstruction of Pier No. 4 of the Aqueduct Bridge, District of Columbia, opened by Lieut. Col. Chas. J. Allen, Corps of Engineers, April 30, 1897.

Material.	Estimated quantity.	Houston Construction Co., Philadelphia, Pa.		Albert Weber, Baltimore, Md.	
		Price.	Amount.	Price.	Amount.
	Cu. yds.				
Repair and maintenance, false work and cofferdam		$5,500.00	$5,500.00	$1,800.00	$1,800.00
Pumping out cofferdam		5,000.00	5,000.00	1,675.00	1,675.00
Removal of false work and cofferdam		3,000.00	3,000.00	6,000.00	6,000.00
Removal of old masonry	1,470	1.50	2,205.00	4.00	5,880.00
Excavation, etc	300	2.00	600.00	3.00	900.00
Concrete	210	7.75	1,627.50	12.00	2,520.00
Ashlar masonry	460	15.00	6,900.00	18.00	8,280.00
Header masonry	45	23.00	1,035.00	10.00	450.00
Rubble masonry	620	6.00	3,720.00	6.00	3,720.00
Removing and resetting coping	21	10.00	210.00	9.50	199.50
Repair of iron trusses		200.00	200.00	575.00	575.00
Total			29,997.50		31,999.50
Time of commencement		May 30, 1897		May 20, 1897.	
Time of completion		Nov. 1, 1897		Feb. 21, 1898.	

Material.	Estimated quantity.	Howlett & Burns, Washington, D. C.		Jutte & Foley Co., Pittsburg, Pa.		R. H. Hood, Washington, D. C.
		Price.	Amount.	Price.	Amount.	
	Cu. yds.					
Repair and maintenance, false work and cofferdam		$1,650.00	$1,650.00	$2,000.00	$2,000.00	
Pumping out cofferdam		1,950.00	1,950.00	3,000.00	3,000.00	
Removal of false work and cofferdam		1,800.00	1,800.00	3,000.00	3,000.00	
Removal of old masonry	1,470	5.94	8,731.80	5.44	7,996.80	
Excavation, etc	300	8.00	2,400.00	3.00	900.00	
Concrete	210	9.00	1,890.00	12.00	2,520.00	
Ashlar masonry	460	22.89	10,529.40	21.50	9,890.00	
Header masonry	45	20.00	900.00	21.50	967.50	
Rubble masonry	620	17.40	10,788.00	21.50	13,330.00	
Removing and resetting coping	21	3.15	66.15	21.50	451.50	
Repair of iron trusses		50.00	50.00	500.00	500.00	
Total			40,755.35		44,555.80	$31,000.00
Time of commencement		Award of contract.		June 1, 1897.		
Time of completion		150 working days.		Nov. 1, 1897.		

Note.—The bid of R. H. Hood was not made in accordance with printed form.

The contract was awarded to the Houston Construction Company, the lowest bidder. Date of contract, May 17; approved May 28, 1897. Date of commencement, on or before May 30; date of completion November 1, 1897.

APPENDIX A A A.

WASHINGTON AQUEDUCT AND INCREASING THE WATER SUPPLY OF WASHINGTON, DISTRICT OF COLUMBIA.

REPORT OF CAPT. D. D. GAILLARD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

1. Washington Aqueduct.

2. Increasing the water supply of Washington, D. C.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., July 17, 1897.

GENERAL: I have the honor to forward herewith the annual reports for Washington Aqueduct and increasing the water supply of Washington, D. C., for the fiscal year ending June 30, 1897, * * * .

Very respectfully, your obedient servant,

D. D. GAILLARD,
Captain, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

A A A 1.

WASHINGTON AQUEDUCT.

Appropriations for the Washington Aqueduct are applied to the improvement, maintenance, and repair of all of those parts of the water supply that have been placed under the supervision of the Chief of Engineers, except the new reservoir near Howard University and the tunnel connecting it with the distributing reservoir. These are the masonry dam across the Potomac at Great Falls, the works there for regulating the supply to the conduit, the conduit from Great Falls to the distributing reservoir, the three reservoirs for supplying the city, the mains for delivering water from the reservoirs into the city's distributing system, and the two bridges for carrying the mains across Rock Creek.

The water supply is taken from the Potomac River at Great Falls, about 14 miles above the city.

At this point a masonry dam extends across the river from the Maryland to the Virginia shore. Its total length is 2,877 feet, and the width of its crest in the Virginia channel and across Conns Island is 8 feet 3 inches and in the Maryland channel 7 feet 9 inches. In 1895–96 the crest of the dam was raised from a reference of 148 feet above mean tide at the Washington Navy-Yard to 150.5 feet above the same datum plane.

The top of the mouth of the feeder of the conduit at Great Falls is at a reference of 149 feet and the bottom at a reference of 139.5 feet.

The water passes from the feeder through the gatehouse and into the conduit, which at this point has a reference of 152 feet at the interior surface of the crown of the arch.

The slope of the conduit is uniform between the gatehouse at Great Falls and the distributing reservoir and is 9 inches in 5,000 feet.

The conduit is circular in cross section, and for the greater part of its entire length is 9 feet in diameter and composed either of rubble masonry plastered or of 3 rings of brick, but where the soil in which it was built was considered particularly good the inner ring of brick was omitted and the diameter is 9 feet 9 inches. Where the conduit passes as an unlined tunnel through rock the excavation was sufficient to contain an inscribed circle 11 feet in diameter.

The lengths of the conduit and its connections are as follows:

Length of feeder at Great Falls, 256 feet.

Area of cross section at mouth, 157.45 square feet.

Length of conduit between gatehouse at Great Falls and north connection of Dalecarlia Reservoir, 47,896.5 feet; least diameter, 9 feet.

Length of by-conduit around Dalecarlia Reservoir, 2,730.5 feet; diameter for 625 feet, 8 feet; for rest of distance, 9 feet.

Length of conduit between south connection of the Dalecarlia Reservoir and north connection of the distributing reservoir, 10,149.87 feet; diameter of conduit, 9 feet.

Length of by-conduit around the distributing reservoir, 2,274.35 feet; diameter, 7 feet.

At the distributing reservoir the water passes into 4 cast-iron mains 48 inches, 36 inches, 30 inches, and 12 inches in diameter, respectively.

The Dalecarlia Reservoir has a storage capacity of about 150,000,000 gallons, is practically without paved slope wall, is perfectly protected against pollution from the drainage of the surrounding country, and is provided with a spillway, the reference of the bottom of which is 146.5 feet. The reference of the interior surface of the crown of the arch of the conduit at the north connection of this reservoir is 143.77 feet and at the south connection 143.39 feet. The distance between these points, measured along the line of flow of the water across the reservoir, is about 3,550 feet.

The distributing reservoir has a storage capacity of about 150,850,000 gallons and is divided by a puddled and paved wall, through which is a passageway which can be closed with stop planks, into two sections, containing 97,600,000 and 53,250,000 gallons, respectively.

The interior surface of the crown of the arch of the conduit at the north connection of this reservoir has a reference of 141.87 feet.

The Georgetown high-service reservoir is circular in plan and has an available capacity of about 1,500,000 gallons. The reference of its water surface when the reservoir is full is 220.5 feet. Although this reservoir is under the charge of this office, the duty of keeping it filled by pumping devolves upon the water department of the District of Columbia.

In addition to the three reservoirs already mentioned, which form a part of the aqueduct system, there is another reservoir, built and controlled by the Commissioners of the District of Columbia, called the Fort Reno reservoir, with a capacity of about 4,500,000 gallons, the reference of its water surface when the reservoir is full being about 420 feet.

This reservoir, like the high-service reservoir in Georgetown, is supplied with water taken from the supply mains by the U street pump.

The Dalecarlia and distributing reservoirs supply this station and that part of the District which lies below 100 feet above datum. The areas lying between the levels of 100 and 210 feet above datum are supplied by pumping from the U street station directly into the distributing mains, the Georgetown high-service reservoir being held as a reserve supply. The areas having a greater elevation than 210 feet above datum are supplied from the Fort Reno reservoir.

It will be observed, therefore, that the total present storage capacity of all reservoirs is a little less than 307,000,000 gallons, or about seven days' normal supply.

Until the average daily consumption of water becomes considerably greater than at present, the reference of the surface of the water at the lowest stage of the Potomac will be about 151 feet at the mouth of the feeder at Great Falls, about 146.75 feet at the Dalecarlia reservoir, and 146 feet at the distributing reservoir.

From August 17 to November 16, 1896, Maj. Charles J. Allen, Corps of Engineers, was in temporary charge of the Washington Aqueduct and its accessory structures during my absence on duty in Alaska.

The following statement shows the operations upon the aqueduct and its accessory works during the fiscal year and their condition at its close:

GATEHOUSES, WATCHMEN'S QUARTERS, AND OTHER BUILDINGS.

The watchman's house at the Dalecarlia Reservoir was furnished with a new roof and a complete set of new window shutters. The laborer's house at the same reservoir was extensively repaired throughout. The engine house on the Virginia shore at Great Falls was provided with a new felt roof.

The four gatehouses at the Dalecarlia and distributing reservoirs, and the house over the entrance to the valve chamber at the latter, which had become much discolored and weather-stained, were covered with a wash of Portland cement, which greatly improved their appearance. All other buildings were repainted or whitewashed, and such minor repairs as were necessary for their proper preservation were made.

THE RESERVOIRS.

The improvement of the Dalecarlia Reservoir was completed under the supervision of Col. George H. Elliot, United States Corps of Engineers, retired, on November 15, 1895, with the exception of the acquirement by condemnation of a small piece of land, four hundred and eight one-thousandths of an acre, the property of John P. Hickey, proceedings for the acquirement of which were in progress at the close of the last fiscal year. These proceedings were completed early in the present fiscal year and the award was paid to Mr. Hickey on September 5, 1896.

The works were designed to divert from the reservoir the drainage from a watershed of about 3,825 acres, which drainage had so polluted its waters as to cause the reservoir to be thrown out of service in the spring of 1888.

This drainage formerly entered the reservoir by three streams, Little Falls Branch, Mill Creek, and East Creek, with drainage areas of about 2,700, 900, and 225 acres, respectively.

The plan of improvement adopted consisted in constructing dams across these streams just above their mouths, and carrying the waters of East Creek by an open intercepting channel around the margin of the reservoir into Mill Creek above its dam, from which point by a similar and proportionally longer channel around the reservoir and a short tunnel through a hill the drainage of the two streams and the slopes adjacent to the open channels were carried into Little Falls Branch above its dam.

The drainage of the entire watershed, thus collected, was carried into a shaft 51 feet deep, excavated in the bed of the latter stream. From the bottom of this shaft a tunnel 1,000 feet long and 7 feet in diameter carries the water under Dalecarlia Hill to its former course leading into the Potomac River.

These works are in excellent condition, are very sightly in appearance, and effect perfectly the object for which they were designed.

A large number of trees blown down in the storm of September 29, 1896, near the northwest shore of this reservoir were cut up and removed, and the underbrush, leaves, and straw around the borders of the reservoir have been burned or carted away. Some of the more irregular banks of this reservoir were graded and the excess of materials used in filling the few shallow, marshy portions of the reservoir.

The unsightly spillway was extensively repaired and its appearance much improved thereby. A gauging weir for computing the overflow of the spillway was constructed in the channel beneath the wooden bridge. A boathouse in course of construction near the south connection of the reservoir will afford much needed protection for the boat used in operating the works at this reservoir.

An iron hand rail was placed around the shaft at the Dalecarlia Reservoir as a measure of precaution against accidents.

About 800 feet of the wooden fence around the distributing reservoir damaged by the storm of September 29, 1896, was repaired, and a number of ornamental plants and grasses were set out around the borders of the reservoir.

During the past three months the fences around both reservoirs have been extensively repaired and all of them have been whitewashed.

All cracks in the bottom and along the sides of the high-service reservoir in Georgetown were plastered up, and the interior surface was carefully covered with several washes of Portland cement to prevent exfiltration. The exterior was much improved in appearance by two washes of Portland cement over all masonry and two coats of paint on all ironwork of the reservoir and on the iron fence surrounding it.

During the past year, not including the few occasions when the water was lowered by the supply being shut off for the purpose of repairs or of removing deposits from the conduit, the extreme fluctuations of the level of the water in the distributing reservoir had a range of but 1 foot as against 1.80 feet for the preceding year and 4.1 feet in 1894-95, the corresponding heights being as follows:

Year.	Lowest.	Date.	Highest.	Date.	Range.
	Feet.		*Feet.*		*Feet.*
1894-95	141.45	February, 1894	145.55	March, 1895	4.1
1895-96	144.15	July, 1895	145.95	April and May, 1896	1.8
1896-97	145.08	January 30, 1897	146.08	November 29, 1896	1.0

It will be observed that the lowest stage of this reservoir during the fiscal year was 0.93 foot higher than the lowest stage during the preceding fiscal year and 3.63 feet higher than during the year before that. With the exception of the intensely cold period from January 27 to February 3, 1897, the water level in the reservoir at no time fell below 145.6 feet above datum.

This marked improvement in the normal level of the reservoir arises from three causes: First, raising the dam at Great Falls; second, removing deposits from the conduit, and third, putting the Dalecarlia reservoir into service. From the spring of 1888 until July 27, 1895, this reservoir was out of service, and a sudden demand upon the comparatively small supply stored in the distributing reservoir affected its level much more than at present, when it is connected with the Dalecarlia Reservoir. In addition, when the latter reservoir was out of service the water was carried around it by means of a by-conduit, which for 625 feet of its length has a diameter of but 8 feet, and serves to throttle the flow materially. Since this reservoir has been put in service no throttling occurs and the flow is increased.

THE CONDUIT AND THE BY-CONDUITS.

With the amount appropriated by the act of March 2, 1895, the entire conduit and both by-conduits had been thoroughly cleaned during the preceding fiscal year for the first time since their construction, and 8,946 cubic yards of deposit had been removed therefrom. During the operations connected with the removal of these deposits a large number of longitudinal cracks were discovered and were carefully plastered up with cement mortar. A detailed description of all operations connected with the removal of deposits and a table showing the location of the cracks are given in Appendix B B B of the Report of the Chief of Engineers for 1896.

During the months of May and June, 1897, all deposits were removed from the entire conduit between Great Falls and the distributing reservoir, and from the by-conduit around the distributing reservoir, and the interior of both the conduit and by-conduit was carefully scraped and swept. About 165 cubic yards of deposits were removed between Great Falls and the Dalecarlia Reservoir, and about 5 yards between the two reservoirs. An attempt was made to clean the by-conduit around the Dalecarlia Reservoir, but when it was entered for this purpose the north connection, which has been in particularly bad condition for several years, was judged to be too unsafe to warrant the risk of keeping men at work in the by-conduit.

This by-conduit, which is 2,730.5 feet in length, and is a useful part of the aqueduct system, was constructed during the civil war, when the aqueduct was under charge of the Department of the Interior, but the rubble masonry used in its construction was of very inferior quality, and it has been in a leaky condition for many years.

For a part of its length it is located too near the reservoir, the banks of which in this vicinity are very steep, and should it ever become necessary to draw off all of the water from this reservoir there is very grave danger that, relieved of the water pressure from the reservoir, portions of the bank between the by-conduit and the reservoir will slip into the latter, as has been the case on two occasions heretofore, and breaks in the by-conduit will result. To afford even a fairly efficient service the entire north connection and the portion of the by-conduit adjacent to it must be rebuilt, and an estimate for doing this work is submitted in the proper place.

The deposits removed during the present fiscal year were confined almost exclusively to the seven unlined 11-foot tunnel sections and to the thirteen 9-foot 9-inches enlarged brick and masonry sections.

A careful inspection of the conduit, made while the work of removing deposits was in progress, shows that none of the cracks plastered up during the preceding fiscal year have opened, and that no new ones have developed. A new board walk was constructed in the tunnel leading to Wasteweir No. 2.

THE CONDUIT ROAD AND ITS FENCES.

For use in repairing the Conduit road 1,714 cubic yards of flint stone were purchased during the fiscal year. The following quantities of stone were crushed and spread upon the Conduit road at the localities mentioned below:

Forty-five cubic yards of flint stone near the distributing reservoir, 356 cubic yards of blue stone near the Dalecarlia Reservoir, and 9[illegible] cubic yards of flint stone between Cabin John Bridge and Bridge No. 1. The breaking of the crusher and the low state of the annual appropriation prevented the crushing of the remainder of the flint stone purchased.

Extensive repairs were made to the dirt road between the Club House and Great Falls, a distance of about 2½ miles. General repairs were made to all other portions of the road, ditches were cleaned, bushes cut down, slopes trimmed, and deposits removed from culverts.

A new painted board fence was erected on each side of the road at the northwest approach of Cabin John Bridge.

All of the guard fences on the embankments along the Conduit road have been extensively repaired and whitewashed.

Year by year the travel on the Conduit road, which is the most beautiful driveway in the vicinity of Washington, increases, and with it increases the amount of road metal necessary to keep the road in repair, until at the present time the cost of repairing this road entails a most serious drain upon the very limited annual appropriation for the maintenance of the Washington Aqueduct and its accessory structures, amounting during the past two years for the surface repairs of the road alone to more than 12 per cent of the total annual appropriation for the Washington Aqueduct during that period.

Although the Conduit road is the property of the Washington Aqueduct, it is so extensively used as a public driveway that it does not seem fair to charge the annually increasing cost of maintaining it entirely against the appropriation for supplying the District of Columbia with water, thereby reducing the amount available for use on other parts of the system.

Although much appreciated in its present condition by the thousands of persons who use it, the condition of the road would be greatly improved if a fixed amount were appropriated annually, exclusively for supplying and spreading road metal upon the road, the repairs to culverts, ditches, bridges, etc., being essential to the safety of the Washington Aqueduct, to be paid as at present from the regular appropriation for the maintenance and repair of the Washington Aqueduct.

An estimate of the annual cost of supplying and spreading road metal upon the Conduit road between Georgetown and the Club House is accordingly submitted in the proper place.

THE MAINS.

The trunk mains, aggregating 21 miles in length, which lead from the distributing reservoir and supply the distributing system of street mains, were laid by the United States and are under the control of this office, but the distributing mains were laid by the District of Columbia and are under the care of the Commissioners of the District.

By act approved June 11, 1896, $5,000 was appropriated for inserting air valves and blow-off valves in the 36-inch and 30-inch mains.

The project for this work was approved on June 26, 1896, and operations were commenced in October, 1896, and completed in February, 1897.

With this appropriation air valves and blow-off valves with the necessary casings, covers, masonry work, etc., were inserted in the 36-inch and 30-inch mains at the following places:

12-inch blow-offs in the 36-inch main.

One at New Jersey avenue and L street NW.

3-inch air valves in the 36-inch main.

One in vault at distributing reservoir.
One at Thirty-fourth and M streets NW.
One at Thirty-second and M streets NW.
One at Twenty-fourth and L streets NW.
One at Eighteenth and L streets NW.
One at Eleventh and L streets NW.

12-inch blow-offs in the 30-inch main.

One at Twenty-first and K streets NW.
One at Sixteenth and K streets NW.
One at Massachusetts avenue between Fourth and Fifth streets NW.
One at New Jersey avenue and K street NW.

3-inch air valves in the 30-inch main.

One in vault at distributing reservoir.
One at Thirty-fourth and M streets NW.
One at Thirty-second and M streets NW.
One at Pennsylvania avenue between Twenty-third and Twenty-fourth streets NW.
One at Nineteenth and K streets NW.
One at Thirteenth and K streets NW.
One at Third street and Massachusetts avenue NW.
One at New Jersey avenue and I street, NW.
One at New Jersey avenue and B street NW.

From the annual appropriation for maintenance and repair of the Washington Aqueduct, a 12-inch blow-off was placed in the 48-inch main at New Jersey avenue and L street NW.

The air valves and blow-offs were all inserted by the use of the A. P. Smith tapping machine without the necessity at any time of shutting off the water from the mains.

In doing this work the pieces cut out of the mains indicated their condition as regards "tuberculation," which was as shown in the following table:

Diameter of main.	Date when main was laid.	Condition of interior when laid.	Present condition of interior.	Size of maximum observed tubercle in inches.
30 inches	1858	Not coated	Completely covered with large tubercles.	0.7 by 2 by 2.25
36 inches	1872	Coated with coal-tar varnish.	A single tubercle on a circular piece 12 inches in diameter; coating badly blistered.	0.3 by 1.25 by 2
48 inches	1883	Coated with coal-tar varnish.	No tubercles. Coating slightly blistered.	

From this it will be observed that the interior of the 30-inch main is in such poor condition that the velocity of flow through it must be greatly retarded by friction.

During the construction of the large intercepting sewer by means of a tunnel under the east abutment of the M Street Bridge over Rock Creek, it was observed that the street above the tunnel was settling, and with it the 48-inch main, one joint of which rested rigidly on the stone abutment of the bridge, causing slight leakage to develop in the joints of the main. These were promptly calked, and to prevent trouble from possible future settlement the main was supported by two braced iron girders resting upon concrete piers. This work was done at the expense of the District of Columbia, as the support was rendered necessary on account of the construction of the intercepting sewer.

An 8-inch cast-iron drain was laid from the valve vault of the 36-inch main near Foundry Branch to the branch, a distance of 60 feet.

A new platform was built around the 48-inch gate in the vault at New Jersey avenue and L street NW.

A break in the 24-inch main on K street, between Eighth and Ninth streets NE., was repaired, and leaks in the mains at the following points were discovered and stopped by recalking the joints:

48-inch main.

Leaks in several joints on M street near Thirty-second street.
A leak in the joint on M street near Twenty-sixth street.
Leaks in several joints under the M Street Bridge.
Leaks in several joints in the east abutment of the M Street Bridge.

36-inch main.

A leak at College Pond.

30-inch main.

A leak at College Pond.
A leak at New Jersey avenue and D street.

12-inch main.

A leak on M street near Thirty-second street.
Leaks in the east abutment of the Pennsylvania Avenue Bridge.

All pipe vaults have been cleaned and valves have been oiled and worked regularly.

Section 1803, Revised Statutes, forbids the tapping of any main laid by the United States in the District of Columbia except by permission of the Chief of Engineers, United States Army.

Upon recommendation of Col. George H. Elliot, Corps of Engineers, in letter dated December 31, 1894, concurred in by the Chief of Engineers and approved by the Secretary of War, general authority was granted to the Commissioners of the District of Columbia to tap all the United States mains in the District of 12 inches in diameter and under at their pleasure, with the exception of the 10-inch main in Georgetown between its valve just north of M street and the Rock Creek Aqueduct Bridge at Pennsylvania avenue, the 12-inch main on the Conduit road between the distributing reservoir and Foxhall Hill, and the 12-inch main on the Canal road.

Permission was given by the Chief of Engineers to Mrs. Ellen O'Neil to tap the 12-inch main with one 1-inch tap on the Conduit road in front of lot F in Harlem for a building erected on that lot, and to Messrs. S. S. Shedd & Bro., for Mrs. H. Semken, owner, to tap the 30-inch main with one 1-inch tap for the supply of premises No. 1407 K street, and by the officer in charge of the Washington Aqueduct to the Commissioners of the District of Columbia to connect a fire hydrant on Massachusetts avenue between Fourth and Fifth streets with the 12-inch blow-off on the 30-inch main.

THE BRIDGES.

All of the bridges are in excellent condition, with the exception of the wooden flooring of the roadway over the Pennsylvania Avenue Bridge and that of the wooden bridge across the spillway of the Dalecarlia Reservoir, both of which are considerably worn and will soon require renewal.

The roadway of Pennsylvania avenue, which in the vicinity is 53.5 feet in clear width, is contracted on the bridge to a clear width of but 17 feet, and as drivers are required to walk their teams while passing over the bridge, a congestion of travel results during the busiest hours of the day, causing delay and annoyance, as there is not room for one team to pass another, and consequently the speed of all teams on the bridge moving in the same direction is limited by that of the team in front. Especially is this annoyance felt by the thousands of bicycle riders who daily pass over the bridge and who, unless experienced riders, are frequently forced to dismount and lead their bicycles over the bridge, the rate of progress of the teams blocking the roadway ahead, being too slow to allow an inexperienced rider to maintain equilibrium. In addition, the sightly appearance of the avenue is much injured by the extreme contraction at this point.

This bridge, the property of the Washington Aqueduct, is very graceful in appearance and is unique among the bridges of the world, in that the roadway is supported upon arched ribs formed by two 48-inch cast-iron pipes, through which flows at least half of the water consumed by the city. It would seem therefore that any plan to widen the bridge should preserve both the graceful form and the distinctive features of the bridge.

A Board of Engineers, constituted by Special Orders No. 8, February 2, 1877, and composed of the following officers of the United States Corps of Engineers, Bvt. Maj. Gen. Z. B. Tower, Bvt. Maj. Gen. H. G. Wright, and Bvt. Maj. Gen. Q. A. Gilmore, was assembled to examine into the propriety of certain proposed modifications of this bridge. This Board after due consideration of the matter reported as follows:

> It would, in our opinion, therefore, better accord with the position on Pennsylvania avenue and with the general character and architectural effect of other aqueduct structures to widen this structure, without changing its design, by the addition of two arched iron ribs similar to those of the present bridge and by widening the abutments.
>
> These two arched ribs should be made about as heavy as those of the present bridge. As the previous discussion shows the latter to be abundantly strong without the truss work, in the new construction the greater portion of the whole weight of the bridge could be thrown upon the added arches, not used as water pipes.
>
> We regard the arch as far more sightly, beautiful, and architectual than the truss, and therefore more suitable for this position.

On April 26, 1877, the late Gen. Thomas L. Casey, United States Corps of Engineers (retired), then in charge of the Washington Aqueduct, was requested by the Chief of Engineers to investigate and report upon "the present and prospective use of that bridge as a highway, etc." This he did on July 19, 1877, his report concluding with the following opinion:

> I am further of opinion that the present and prospective interests of the citizens of Washington and Georgetown do demand an increase in the width of the roadway

and of the footway, the present width being, of the roadway only 17 feet, and of the footways 4½ feet each.

The abundant strength and stiffness of the present bridge, under any statical or moving loads that are likely to be placed upon it, are clearly shown by the investigations of the Board of Engineers, as detailed in its report of April 7, 1877, and I agree with it as to the manner in which the widening of the road and footway should be accomplished, should it be decided to increase their width, namely, by the addition of two arched iron ribs, similar to those of the present bridge, and by widening the abutments. The estimated cost of widening the bridge in the manner above stated is $75,000.

While I believe that the interest and convenience of the citizens of Washington and Georgetown demand the widening of this bridge, yet because the present structure amply suffices for all requirements of the Washington Aqueduct system, and because during the past few years no official complaints regarding the width of the bridge have been made to this office, no estimate is submitted for this work, the estimates for the next fiscal year being confined to those subjects directly affecting the operation of the Washington Aqueduct.

THE TELEPHONE LINE.

This line connects the office in Georgetown with the dwellings of the watchmen at the distributing and Dalecarlia reservoirs and Great Falls and forms an essential component of the Aqueduct system. Its total length is about 14½ miles, and the direct circuit is afforded by means of a single No. 9 galvanized iron wire supported on brackets fastened to poles at considerable distances apart. The return circuit is through the earth.

Although extensively repaired in the fall of 1895 and supplied with new telephones, the line has required numerous repairs during the present fiscal year, and has afforded very unsatisfactory service, due, it is believed, to causes which no amount of repairing can overcome.

In accordance with the recommendation of this office an appropriation of $5,000 was made in the act approved March 3, 1897 (Public—No. 129), for constructing a new telephone line between the Aqueduct office and Great Falls.

A project for the expenditure of this appropriation was submitted on May 25, 1897, and approved by the Chief of Engineers on May 27. Proposals for furnishing materials for constructing the new line were opened June 15, 1897, and the award made to the lowest bidder. With the materials thus purchased it is proposed to construct with hired labor, early in the next fiscal year, a new line provided with a pair of No. 12 B. S. copper wires stretched on cross arms, and to equip this line with first-class long-distance telephones.

THE AQUEDUCT LANDS.

By act of Congress (Public—No. 74) approved April 6, 1896, Margaret Shugrue, Caroline Lochboehler, and John R. Scott were authorized under certain conditions to purchase, at prices to be determined by the Secretary of War, certain tracts of land the property of the Washington Aqueduct, of which they had been for many years in uninterrupted possession under the belief that they were bona fide owners. No action having been taken by these parties to purchase the lands named in the act, they were all, upon recommendation of the officer in charge of the Washington Aqueduct, which was approved by the Secretary of War, served in April, 1897, with a notice setting a price upon the lands and stating that unless payment was made within four months after the receipt thereof steps would be taken to recover possession of said tracts for the United States, and to fence in the same for the use of the Washington Aqueduct.

Up to date, so far as this office is informed, John R. Scott is the only one of the parties who has instituted steps to purchase the land.

The purchase of the tract of land containing 0.408 acre, owned by John P. Hickey, and situated on the Conduit road on Dalecarlia Hill, was completed and the award for the same paid on September 5, 1896.

By act of Congress (Public—No. 178) approved June 3, 1896, the Washington and Great Falls Electric Railway Company was granted permission to cross the lands of the Washington Aqueduct at Chautau-ua, under certain conditions to be imposed by the Secretary of War. These conditions were all complied with, and the tracks across the and in question were completed early in the fiscal year.

On September 19, 1895, the Washington and Great Falls Electric Railway Company submitted plans for carrying their tracks over the United States mains on Foxhall Hill. These plans were approved on September 20, 1895, and at the close of the preceding fiscal year had been completed by the company, under the supervision of this office, with the exception of two piers under the side track, which have since been completed.

On June 6, 1896, the Secretary of War approved the plans and location of the proposed crossing of the Conduit road at Glen Echo by the Glen Echo Railroad Company, authorized by act of Congress (Public—No. 83) approved June 15, 1892, and work upon the crossing was completed on May 21, 1897.

The Secretary of War, on April 15, 1897, granted to Messrs. Bobinger Brothers, proprietors of the Cabin John Bridge Hotel, a revocable icense to construct an asphalt driveway and a granolithic sidewalk on a part of the lands of the Washington Aqueduct at Cabin John Bridge.

On February 6, 1897, the Secretary of War granted permission to Joseph E. Bissett to build a foot bridge across Falls Branch to Falls Island, and on March 5, 1897, to J. W. Carroll, a similar permission. Mr. Bissett has constructed his bridge, but Mr. Carroll has taken no urther steps in the matter.

On April 20, 1895, Mr. Arthur B. Cropley was notified by the officer in charge of the Washington Aqueduct that two of his barns encroached n the lands of the United States, and that if said barns were not emoved within one year from the date of the notice proceedings would e taken to have them removed.

Nothing was heard from Mr. Cropley in reference to the matter, and to arry out the action previously outlined he was notified on April 21, 1896, hat the barns not having been removed, proceedings would at once be stituted to effect their removal. About one year ago the United tates attorney for the district of Maryland was instructed by the Attorney-General, at the request of the Secretary of War, to take proceedngs to cause the removal of these buildings. To aid him in doing this e was furnished by this office with maps, descriptions of the lands, nd all other information requested. One of the barns was completely estroyed during the storm of September 29, 1896, and the district attorey was informed of the fact. The other barn still encroaches on the ands of the Washington Aqueduct, and nothing has been heard from he district attorney in reference to the matter since November 13, 1896.

On November 6, 1895, William and George Bobinger, Arthur B. Cropey, Thomas Dowling, Peter C. Harris, John T. Hill, Alexander Hill, William Kirk, and the Washington Anglers' Association were notified hat their fences were in whole or in part on the lands of the Washington Aqueduct, and that when these fences are rebuilt they must not ncroach on these lands.

It is believed that the following table includes all structures situated in whole or in part on the lands of the Washington Aqueduct.

Persons owning structures on lands of Washington Aqueduct.	Nature of structure.	By what authority structures exist.
Washington and Great Falls Electric Railway Co.	Tracks, wires, etc	Act of Congress.
Glen Echo Railroad Co	do	Do.
John G. Rick	House and fence	Revocable license.
Wm. Burroughs	Shed and fence	Do.
Patrick Finley	House and fence	Land occupied is claimed by Chesapeake and Ohio Canal.
Caroline Lochboehler	House	Authorized to purchase land by act of Congress (Public—No. 74) approved Apr. 6, 1896.
Margaret Shugrue	House, stable, and fence	Do.
J. R. Scott	Fence	Do.
Mrs. C. Shugrue	do	
Cottrell & Clark	do	
John Amberger	do	
Ignatius Belt	do	
Benjamin Newman	do	
Cabin John Bridge Hotel	Shed and fence	
Do	Asphalt driveway	Revocable license.
Thos. Tuohy (since sold to Thos. Cropley).	House and fence	
Arthur B. Cropley	Barn, fence, and hedge	
Thomas Cowling	Fence	
Peter C. Harris	do	
John T. Hill	do	
Alexander Hill	do	
Washington Anglers' Association	do	
Joseph E. Bissett	Bridge	By authority of the Secretary of War.
E. & E. Baltzley	Barn	

CONSUMPTION AND WASTE OF WATER.

Measurements of the daily and hourly consumption and waste of water were made on June 23, 24 and June 29, 30, 1897.

A detailed record of the measurements is given in the following table:

Measurement of daily and hourly consumption and waste of water.

[Hourly and total flow from the distributing reservoir for twenty-four hours ending at 6 a. m.]

Hour.	Outflow per hour (gallons).		Remarks.
	June 23, 24, 1897.	June 29, 30, 1897.	
6 a. m. to 7 a. m	1, 977, 023	1, 975, 576	City temperature in the shade at 2 p. m., June 23, 1897, 82° F. Weather clear.
7 a. m. to 8 a. m	2, 115, 631	2, 114, 289	
8 a. m. to 9 a. m	2, 394, 428	2, 251, 939	
9 a. m. to 10 a. m	2, 250, 242	2, 249, 031	
10 a. m. to 11 a. m	2, 247, 334	2, 105, 573	
11 a. m. to 12 noon	2, 103, 876	2, 102, 907	
12 noon to 1 p. m	2, 241, 276	2, 100, 119	
1 p. m. to 2 p. m	2, 098, 301	2, 097, 454	
2 p. m. to 3 p. m	2, 095, 636	2, 094, 665	
3 p. m. to 4 p. m	2, 092, 847	2, 092, 000	
4 p. m. to 5 p. m	2, 090, 182	2, 228, 428	
5 p. m. to 6 p. m	1, 948, 300	2, 225, 279	
6 p. m. to 7 p. m	1, 946, 118	2, 083, 515	
7 p. m. to 8 p. m	1, 665, 989	2, 080, 607	
8 p. m. to 9 p. m	1, 664, 291	1, 385, 618	
9 p. m. to 10 p. m	1, 801, 085	1, 661, 141	
10 p. m. to 11 p. m	1, 799, 145	1, 659, 444	
11 p. m. to 12 midnight	1, 520, 592	1, 657, 748	
12 midnight to 1 a. m	1, 381, 133	1, 655, 809	City temperature in the shade at 2 p. m., June 29, 1897, 81° F. Weather cloudy during greater part of the day.
1 a. m. to 2 a. m	1, 517, 805	1, 516, 349	
2 a. m. to 3 a. m	1, 378, 587	1, 377, 255	
3 a. m. to 4 a. m	1, 377, 377	1, 651, 083	
4 a. m. to 5 a. m	1, 788, 723	1, 237, 296	
5 a. m. to 6 a. m	1, 786, 994	1, 648, 053	
Total	45, 282, 915	45, 251, 178	

Consumption and waste of water in the city, as measured annually in the latter part of June of each year, from 1874 to 1897, both inclusive.

Year.	Gallons.	Year.	Gallons.	Year.	Gallons.
1874	17,554,848	1882	29,727,864	1890	35,541,845
1875	21,000,000	1883	24,314,715	1891	38,594,743
1876	24.177,797	1884	24,827,113	1892	41,161,780
1877	23,252,932	1885	25,219,194	1893	46,727,108
1878	24,885,945	1886	25,542,476	1894	49,162,357
1879	25,947,642	1887	26,878,424	1895	47,182,681
1880	25,740,138	1888	29,115,774	1896	[a]44,113,574
1881	26,525,991	1889	27,708,779	1897	[a]45,267,047

[a] Mean of two measurements.

By the police census of April 1, 1897, the population of the District of Columbia was found to be 277,782. Of this number Capt. Edward Burr, Corps of Engineers, assistant in charge of the distribution system of the water department of the District, estimates from data in his possession that 261,478 persons are consumers of Potomac water.

Assuming these figures as correct, and taking a mean of the daily consumption and waste measured on June 23, 24, and 29, 30, there is obtained a daily per capita consumption and waste of 163 gallons for every inhabitant of the District of Columbia, and of 173 gallons for every person using Potomac water.

Although the total daily consumption and waste in 1897 is less than in 1893, 1894, and 1895, it is still largely in excess of what it should be.

Careful and trustworthy investigations and measurements made in various cities in the United States show clearly that a per capita daily consumption of 75 gallons is ample for all domestic, business, and public purposes, and that any considerable increase above this amount must be attributed to waste, due to defective mains and service pipes, defective plumbing, and willful waste.

As a rule, any considerable leak in a main or service pipe, being unconnected with a sewer, soon betrays itself and is stopped, consequently the aggregate waste from this cause is comparatively small, and the evil lies principally in defective plumbing and willful waste. To what extent this waste is at times carried may be judged from the following experience:

During a spell of very cold weather lasting from January 25 to February 1, 1897, the daily consumption, which had previously averaged about 42,250,000 gallons per day, rose to an average of more than 52,000,000 gallons per day for seven consecutive days.

During periods of very cold weather the quantity of water actually used for necessary domestic and public purposes is less than usual, and the abnormal consumption at such times is due to the fact that the water pipes in many buildings are so located as to be in danger of freezing unless the water is kept running.

From experiments made in this office it was shown than an increased consumption of 10,000,000 gallons per day, as was the case during the period mentioned, would correspond to about 7,000 ordinary sized spigots running twelve hours per day at the rate usually employed to prevent freezing.

If further proof of waste is required it will be found by consulting the table of daily and hourly measurement of consumption and waste of water, taken on June 23, 24, and 29, 30, 1897, wherein it will be observed that in a residential community like that in question 67 per cent as much water was used between the hours of 1 and 5 a. m., when the consumption is least, as between 7 and 11 a. m., when it is greatest. Moreover, of all the principal cities of the United States, Washington is exceeded by but two or three in its per capita consumption and waste of water.

I would therefore repeat that this extravagant use of water, unless checked, will add greatly to the difficulties and expense of ever providing suitable methods of filtration, as the cost of operation of filter plants after construction varies from about $4 to $8 per 1,000,000 gallons of water filtered.

GAUGING THE CONDUIT.

Under ordinary service conditions the Washington Aqueduct is a submerged masonry conduit for the greater part of its length, the amount of submergence of the crown of the interior varying from zero along the upper part of the conduit to 4.2 feet at the influent gatehouse of the distributing reservoir.

But few results of gaugings made under similar circumstances are on record, and, previous to 1896, but a single attempt to measure the velocity of flow in the Washington Aqueduct had been made, namely, by Gen. M. C. Meigs, March 15, 18, 1860, when the conduit was flowing less than half full, a condition very different from that which now exists.

With the completion of the work of raising the dam at Great Falls was brought to a conclusion the last operation of consequence necessary to develop the maximum flow of the conduit. As all deposits had been removed from the conduit during the fiscal year ending June 30, 1896, and the entire interior had been carefully scraped and swept, it seemed very desirable to undertake a series of measurements which would indicate the ultimate capacity of the conduit.

Accordingly, a Buff & Berger current meter (No. 2260), similar to that used in gauging the new Croton Aqueduct and provided with an electric register, was purchased. This meter, through the kind permission of Mr. F. H. Newell, hydrographer in charge, United States Geological Survey, was accurately rated on the track along the shore of Chevy Chase Lake.

Before going into further detail a description of the Washington Aqueduct and of the gauging stations is necessary.

The aqueduct proper consists of two divisions, the upper division extending from the gatehouse at Great Falls to the north connection of the Dalecarlia Reservoir, a total length of 47,896.5 feet. On this division there are seven very rough unlined tunnel sections, aggregating 4,364 feet in length, approximately circular in cross section, and averaging about 135 square feet in cross-sectional area.

There are also thirteen abruptly enlarged masonry sections, aggregating about 3,500 feet in length, plastered in the interior, the cross section being circular and 9 feet 9 inches in diameter. The rest of the upper division is of the normal circular cross section, 9 feet in diameter, and plastered in the interior. The three different circular cross sections have centers in common.

The inclination of the axis of the conduit on both divisions is 9 inches in 5,000 feet, or a slope of 0.00015.

On the upper division there are 62 manholes and ventilators, rising as circular wells 3 feet in diameter from the top of the conduit, and an abruptly enlarged chamber at wasteweir No. 2, near the Dalecarlia Reservoir.

This division contains 79 curves, aggregating 13,952 feet in length, and having an average radius of 469.5 feet.

The lower division of the aqueduct extends from the south connection of the Dalecarlia Reservoir to the influent gatehouse of the distributing reservoir, a total length of 10,149.9 feet. The cross section on this entire division is the normal circular one 9 feet in diameter. The interior is well plastered. On this division there are 14 manholes and ventilators, similar to those described on the upper division, and three abruptly enlarged chambers, one at the effluent gatehouse of the Dalecarlia Reservoir, one at wasteweir No. 3, and the other at the influent gatehouse, distributing reservoir.

This division contains twelve curves aggregating 2,151 feet in length and having an average radius of 427.3 feet.

As the Conduit road is located over the aqueduct, the gauging stations had to be selected so as not to interfere with the very extensive travel on the road. This practically limited their selection to the two points shown on sheet No. 1.

Gauging station No. 1, on the lower division, is located on a curve 409 feet in length, having a radius of 603.3 feet, the station being 125 feet from the upper end of the curve. Water levels were noted hourly at the two extremities of the division.

In taking observations the meter was arranged as shown on sheet 2, so that by simply fastening the pointer in any marked hole on the index frame above the manhole the meter would occupy the corresponding position inside the conduit. In all, thirty-three positions inside the conduit (see sheet No. 2) were occupied at each gauging station, the course of procedure being as follows: The meter was placed at position A, and after the meter had obtained an approximately regular rate of revolution the number of revolutions in one minute was noted and recorded. The meter was then moved successively to each of the positions B_1, B_2, B_3, etc., C_1, C_2, C_3, etc., D_1, D_2, D_3, etc., ending with D_{12}, and the number of revolutions in one minute at each of these positions was noted and recorded as before. the series constituting a "half set."

With as little delay as possible the positions were then occupied in reverse order, beginning with D_{12}, D_{11}, D_{10}, etc., and ending with A, thus completing "one set" of observations. The mean of the two results obtained at each of the thirty-three positions of the meter was taken as the true measure of the velocity at the particular point. The cross section of the conduit was divided into sixteen small areas, and the volume of flow per second through each of these areas was computed. The mean velocity was then obtained by dividing the sum of these volumes by the total area of the cross section of the conduit.

Four sets of observations, on three different days, were taken at gauging station No. 1. The results are shown in the following table:

Date.	Mean time.	Mean velocity.	Maximum velocity.	Ratio of mean to maximum velocity.	Difference of head at ends of division.	Length of division.	R.	C.
1896.		*f. s.*	*f. s.*		*Feet.*	*Feet.*	*Feet.*	
August 25	11.47 a. m.	1.169	1.45	0.806	[a]0.569	10,150	2.25	104.1
July 29	2.23 p. m.	1.267	1.65	.768	.649	10,150	2.25	105.6
Do	12.07 p. m.	1.279	1.65	.775	.639	10,150	2.25	107.4
September 24	12 m	1.234	1.67	.799	.739	10,150	2.25	104.2
Mean				.787				105.3

[a] These differences were established by four lines of level between the two ends of the lower division, the extreme results differing by 0.058 foot. The mean of the four was assumed as correct.

Submergence of crown of interior of lower division of conduit.

Date.	Hour.	Amount of submergence.		Sine angle of slope of conduit=S.
		At upper end of division.	At lower end of division.	
1896.		*Feet.*	*Feet.*	
August 25	11.47 a. m	3.2	4.2	0.00015
July 29	2.23 p. m	3.2	4.1	.00015
Do	12.07 p. m	3.2	4.1	.00015
September 24	12 m	3.1	3.9	.00015

For details as to the variation of velocities in the plane of the cross section of the conduit see curves showing velocity in the conduit at gauging station No. 1, transmitted herewith.

On March 15–18, 1860, Gen. M. C. Meigs, then in charge of the Washington Aqueduct, made some experiments to determine the velocity in that part of the lower division of the conduit included between gauging station No. 1 and wasteweir No. 3, which he described as follows:

> From the 15th to the 18th of March, 1860, wishing to draw out some of the water from the receiving reservoir, I caused the gates of the wasteweir (No. 3) between the two reservoirs to be opened, admitted the water through the gate at the receiving reservoir, allowed the water to flow freely until it had established its regimen, and the flow had become uniform. I dropped a float into the aqueduct through the waste valve near the gatehouse (gauging station No. 1) proceeded to the lower wasteweir and noted the time of the arrival of the float at that point. This was repeated several times. The distance traversed by the float was 7,320 feet; average time occupied by several floats in traversing this distance, 3,171 seconds; surface velocity in the middle of the current, 2.3084 feet per second. Depth of water in the conduit during the experiment 3.465 feet. * * *
>
> The area of the water section during this experiment was 22.527 square feet; the wet perimeter 12.024 feet. Assuming the formula $v = V \times 0.8369 =$ mean velocity, we should have for the mean velocity 1.9319 feet per second, etc.

The sine of the angle of slope of the water surface being that of the conduit itself was $=0.00015$, and the hydraulic radius deduced from the figures given is 1.873 feet.

Substituting these values in the formula $V = C\sqrt{RS}$ and using General Meigs's value for the mean velocity we have $C = 115.3$.

If, as was probably the case, the floats did not remain in the middle of the surface current during their passage, but occupied various positions thereon, the ratio of the float velocity to the mean velocity would probably have been greater than that used by General Meigs. In the experiments on the new Croton Aqueduct this ratio is about 0.96 or 0.97. Using the first number, we obtain a value of 2.216 foot-seconds for the mean velocity, and a value of 132.2 for C, a result which differs very considerably from those deduced from the current meter observations already described.

Gauging station No. 2 is situated on a straight section of 9-foot conduit 254 feet in length, well plastered on the inside, which lies between two straight, rough, unlined tunnels, the gauging station being 40 feet below the upper one of these tunnels.

On the upper division, above the gauging station, there are 42 curves of a total length of 6,601 feet and an average radius of 500 feet, and below the station 37 curves of an aggregate length of 7,351 feet and an average radius of 453.7 feet.

Ten sets of observations, on five different days, were taken at gauging station No. 2; the elevation of the surface of the water on the first three dates being read at manhole No. 1, gauging station No. 2, and at the north connection of the Dalecarlia Reservoir, and on the last two dates at bridges 2 and 3 in addition. The results are shown in the tables following.

Hydraulic data relating to the section of conduit between gauging station No. 2 and the north connection of the Dalecarlia Reservoir.

Date.	Mean time.	Mean velocity.	Maximum velocity.	Ratio of mean to maximum velocity.	Difference of head at ends of section.	Length of section.	R.	C.
1897.		*f. s.*	*f. s.*		*Feet.*	*Feet.*	*Feet.*	
June 14	3.50 p.m.	1.055	1.21	0.872	0.717	22,719	2.25	125.2
Do	12.55 p.m.	1.063	1.23	.864	.717	22,719	2.25	126.1
June 10	12.01 p.m.	1.379	1.57	.878	1.207	22,719	2.25	126.2
Do	3.40 p.m.	1.382	1.58	.875	1.217	22,719	2.25	125.9
June 22	3.47 p.m.	1.534	1.74	.882	1.527	22,719	2.25	124.7
Do	11.53 a.m.	1.545	1.72	.898	1.527	22,719	2.25	125.6
July 3	12.13 p.m.	1.765	1.98	.891	2.147	22,719	2.25	121.1
Do	3.36 p.m.	1.800	2.07	.870	2.162	22,719	2.25	123.1
July 8	12.10 p.m.	1.826	2.09	.874	2.217	22,719	2.25	123.2
Do	5.12 p.m.	1.898	2.13	.891	2.217	22,719	2.25	128.1
Mean				.879				124.9

For details as to the variation of velocities in the plane of the cross section of the conduit see curves showing velocity in the conduit at gauging station No. 2, transmitted herewith.

Submergence of crown of interior of above section of conduit.

Date.	Amount of submergence.		Sine angle of slope of conduit=S.
	Gauging station No. 2.	North connection, Dalecarlia Reservoir.	
1897.	*Feet.*	*Feet.*	
June 14	[a] −0.09	+2.63	0.00015
June 10	+0.80	+3.02	0.00015
June 22	+1.12	+3.03	0.00015
July 3	+0.19	+1.47	0.00015
July 8	+0.64	+1.86	0.00015

[a] Minus sign denotes that hydraulic grade line is below crown of arch; plus sign that it is above.

Considering the section of conduit between bridge No. 2 and gauging station No. 2, a distance of more than 17,000 feet, the observations of July 3 show that the water was 0.90 feet below the interior crown of the conduit at bridge No. 2 and 0.19 feet above the crown at the gauging station, and on July 8, 0.35 feet below the crown at bridge No. 2 and 0.64 feet above the crown at the gauging station. Using the mean velocity as determined from the two sets of observations taken at gauging station No. 2 on each of the dates in question, two values of C are obtained for this section of the conduit which differ less than 2 per cent from the mean values of C, determined on the same dates for the section of the conduit between gauging station No. 2 and the north connection of the Delecarlia Reservoir.

Between manhole No. 1 and bridge No. 2 the average slope of the water surface on the dates just mentioned was 0.00015 and 0.000143, respectively, as against 0.0000884 and 0.0000935 for the section between bridge No. 2 and gauging station No. 2, showing that under the same head the former section has a more restricted flow than the latter.

Denoting the lower division of the conduit as Section A, the section between the north connection of the Dalecarlia Reservoir and gauging station No. 2 as Section B, that between gauging station No. 2 and bridge No. 2 as Section C, and that between bridge No. 2 and manhole

No. 1 as Section D, the following comparative table has been prepared to show the characteristics which probably affect the velocity of flow in the conduit:

Section.[a]	Length.	Number of manholes.	Unlined tunnels.		Enlarged sections, 9 feet 9 inches diameter.		Curves.		
			No.	Length.	No.	Approximate length.	No.	Average radius.	Average extent of curves (in arc) per 1,000 feet of conduit.
	Feet.							*Feet.*	°
A	10,150	14	......	....	[b] 0	....	12	427.3	22.4
B	22,719	31	2	1,351	[c] 11	3,000	37	453.7	40.1
C	17,526	22	3	1,189	2	500	28	529.6	28.7
D	7,201	9	2	1,824	....	....	14	440.7	33.2

[a] For location of sections see map, sheet 1.

[b] There are three short abruptly enlarged sections on Section A, i. e., at effluent gatehouse, wasteweir No. 2, and influent gatehouse.

[c] In addition there is a short abruptly enlarged section on Section B, i. e., at wasteweir No. 2.

With the exceptions noted in the preceding table, the entire conduit is of circular cross section, 9 feet in diameter, and is plastered on the interior.

When the lower division of the conduit was cleaned, in June, 1896, it was noticed that the entire interior was covered with a thick, short growth (about one or two-tenths of an inch in length) to which much fine sediment adhered, doubtless increasing the friction of the water against the interior of the conduit. This growth was carefully scraped off, but was found as before when the conduit was cleaned in June, 1897, and was again removed. It was found on both occasions on every part of Section A, but on no other section of the conduit. It is not known to what extent the new growth had progressed when the current meter observations were taken at gauging station No. 1, but it is believed that to this cause may be the small value of C for this division. This opinion is strengthened by the fact that at gauging station No. 1 the mean of the velocities taken at the twelve positions of the meter nearest the wall of the conduit is in every instance much smaller with reference to the corresponding mean velocity than is the case at gauging station No. 2.*

The restriction of the flow in Section D is probably due to the fact that this section has 25 per cent of unlined tunnel, as against 7 per cent on Section C and 6 per cent on Section B. In addition, the tunnels on Section D are the roughest on the entire conduit.

Manholes on sections A, B, C, and D, are at average distances apart of 725, 733, 784, and 800 feet, respectively. It is known that when the crown of the interior of the conduit is submerged the manholes cause disturbances which extend to the bottom of the conduit, as is shown by the fact that in such cases no deposits on the bottom are found under a manhole, although plentiful within a few feet both above and below it.

Sections B and C have apparently about the same values of C, although the former section is considerably the more crooked, and has much the larger number of the 9 feet 9 inches abruptly enlarged sections.

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* Since this report was submitted two extended series of current meter observations have been taken on Section A—one immediately after cleaning the conduit. These observations showed that the growth alluded to decreased the value of C only about 2 per cent.

Although the value of C obtained on different days varied to some extent, yet it may be broadly stated that for both Sections A and B (submerged sections) it remained practically constant for the entire series of observations on each of these sections.

Having discussed the theoretical results of the gaugings, it now remains to show what light they throw upon the more important practical question of the ultimate capacity of the conduit.

The ultimate capacity of the conduit is based upon the assumption that the Potomac is at its lowest stage and that the water in the distributing reservoir is not allowed to fall below the reference of 144 feet above datum, which is about 2 feet below its present level, but is above the level to which it fell on numerous occasions in 1893, 1894, and 1895. Any further lowering of the water in the distributing reservoir would too seriously diminish the storage capacity of the two reservoirs, and would reduce their depths to such an extent as possibly to cause vegetable growth to originate in them.

On July 8, 1897, the Potomac was at about its lowest stage; uniform flow had been established in the upper division of the conduit for about twenty-four hours preceding the observations, and during this time, as determined by computations from the preceding observations, the Dalecarlia Reservoir had been kept at the same level which it would have, provided the distributing reservoir was at the reference of 144 feet above datum and was receiving the same volume of flow as the Dalecarlia Reservoir. Therefore, so far as the upper division of the conduit is concerned, no theoretical quantities are involved, and the maximum discharge is computed from the measured velocity at gauging station No. 2 on July 8, when the assumed conditions actually existed. The mean velocity on this date, as determined from the two sets of observations, was 1,862 feet per second, corresponding to a discharge of 76,554,055 gallons in twenty-four hours.

As the distributing reservoir has no sluice tower or wasteweir by which it can be kept at a constant level without affecting the hydraulic grade line in the conduit, it was impracticable to keep this reservoir at reference 144 and discharge into it the total volume of flow of the upper division. Therefore the difference of head between the two reservoirs necessary to give this discharge was computed from the observations taken at gauging station No. 1 in 1896 (giving to C the value 104), the result obtained being 1.45 feet.

Although the ultimate daily capacity of the conduit is still about 31,000,000 gallons more than the present daily consumption, yet it should be remembered that the consumption is now about 60 per cent of the maximum capacity of the conduit, while ten years ago it was only about 35 per cent of this quantity. Before the consumption equals the maximum capacity of the present conduit another conduit should be completed and be in readiness to furnish the city with an increased supply of water. To construct another conduit from Great Falls to the distributing reservoir would take several years, and in advance of the actual work of construction accurate surveys would have to be made, lands purchased, and the route of the new conduit located. It would therefore seem the part of wisdom not to defer too long the preliminary operations necessary to inaugurate the work. The United States already owns about four-fifths of the land which would be needed for the purpose, and the rest should be acquired while prices are reasonable and few improvements are located on the lands to be purchased, and it is proposed in the next annual report to submit detailed estimates for the preliminary work.

NECESSITY FOR INCREASING THE MEANS OF SUPPLYING WATER FROM THE DISTRIBUTING RESERVOIR TO THE CITY.

The completion of the work of raising the dam at Great Falls and removing deposits from the conduit marks the conclusion of all operations of magnitude necessary to develop the maximum flow of the conduit. The recent current-meter observations show that this maximum flow, provided the distributing reservoir is not allowed to fall more than 2 feet below its present level, is about 76,500,000 gallons in twenty-four hours or about 31,000,000 gallons per day more than the present daily consumption—a very satisfactory condition of affairs so far as this part of the system alone is concerned.

For several years the trunk mains leading from the distributing reservoir to the city have been overtaxed and their limit of efficient flow has already been reached. Every additional increase in the volume of flow through these mains will be marked by a rapid decrease in pressures in those parts of the city supplied by gravity alone.

It therefore is seen that the aqueduct system is capable of bringing to the distributing reservoir daily about 31,000,000 gallons more water than it can efficiently supply to the city from that reservoir.

Consumers of Potomac water will experience but little practical benefit from the completion of the work of raising the dam and removing deposits from the conduit until some method is provided for bringing an additional supply of water from the distributing reservoir to the service mains of the city.

A commission of experts appointed by authority of the Secretary of War in November, 1895, reported that the completion of the unfinished tunnel between the distributing and Howard University reservoirs furnished the most economical method "for bringing increased water supply from the reservoir in Georgetown to Washington by pipes or otherwise."

In accordance with this report I therefore submit in the proper place an estimate for resuming and completing work upon the Aqueduct Tunnel and the new reservoir near Howard University.

EXPLANATION OF ESTIMATES.

Repairing north connection of by-conduit, Dalecarlia Reservoir.—Should the water in the Dalecarlia Reservoir ever become so polluted from any cause as to render it unfit for drinking, the total supply for the city would have to pass through the by-conduit, which is now in such bad condition at its upper end as to permit the free interchange of its waters with those of the reservoir. In view of the completion of the excellent system of protection works around the reservoir, contamination through drainage from the surrounding watershed seems a very remote contingency, yet should it ever occur the consequences, in the present condition of the by-conduit, would be so grave that it is unquestionably the part of wisdom to keep this by-conduit always in as good condition as its faulty construction will permit. It is believed that the north end of this by-conduit can be repaired at a cost not to exceed $3,000 and an appropriation of this amount for the purpose specified is recommended.

Repairing the conduit road.—Travel upon this road is increasing so rapidly every year that it is impossible to keep it in proper condition out of the present appropriation, without detriment to other more important parts of the aqueduct system. The road, however, forms so popular, useful, and beautiful a highway, that its condition should be improved from year to year, rather than allowed to deteriorate as must of necessity be the case if the road must be kept up solely from the very limited appropriations for the operation, maintenance, and repair of the Washington Aqueduct. I therefore urgently recommend that hereafter an annual appropriation of $5,000 be made for the specific purpose of repairing the conduit road, the care of culverts, ditches, slopes, etc., to be paid as heretofore from the annual appropriation for the Washington Aqueduct.

Completing the Washington Aqueduct tunnel and new reservoir.—As previously explained, the Washington Aqueduct is now capable of delivering into the distributing reservoir in Georgetown, at its maximum discharge, about 31,000,000 gallons per day more than the overtaxed trunk mains can efficiently carry into the city. A commission of experts appointed by authority of the Secretary of War in November, 1895, reported that the completion of the unfinished tunnel between the distributing and new reservoirs furnished the most economical method "for bringing increased water supply from the reservoir in Georgetown to Washington by pipes or otherwise." The completion of this tunnel will necessitate that of the new reservoir.

In view therefore of the report of the commission of experts already alluded to, it is recommended that the sum of $805,850.30 be appropriated for resuming work upon and completing "the tunnel between the distributing reservoir and the new reservoir near Howard University, and for the other works connected therewith, including the latter reservoir."

In connection with this subject it is proper to invite attention to the fact that over $290,000 of the appropriations made by the act of 1882 and by subsequent acts for "increasing the water supply of Washington, D. C.," remains unexpended in the Treasury of the United States. This sum also should be made available for the purposes just indicated.

Storehouse and stable.—A combined storehouse and stable is urgently needed at Great Falls. The present building used for that purpose is a mere wooden shell, old, decaying, unsightly, and insecure, and affords neither adequate shelter nor protection to the valuable Government property stored at the Falls.

I therefore urgently recommend an appropriation of $3,000 for the construction of a combined storehouse and stable of brick, with slate roof.

In previous annual reports recommendations have been made and estimates submitted for certain works necessary for the preservation and repair of the Aqueduct system. In these recommendations and estimates I heartily concur, and the explanation for their necessity and the estimates of their cost are consequently restated.

Storage yard.—The storage yard on the bank of Rock Creek, in rear of and pertaining to the Aqueduct office, is entirely unsuited to the purpose. It is too low, and the route from it to the level of the street being steep and tortuous, before the very heavy castings required for repairs could be hauled out much damage and destruction of property might be done.

A portion of these supplies has been placed in a yard at the distributing reservoir for use in the country portions of the routes of the mains, and the remainder, for use in the city portions of these routes, has been placed in a portion of Twenty-seventh street, near M Street Bridge, which has been loaned for the purpose by the District government until the street is wanted for further improvement.

When this occurs this office will be without a storage yard and one should be purchased as soon as possible. It should be near the office and at or near the grade of the street, so that the heavy castings and machinery needed for repairs can be quickly gotten out.

It is believed that a suitable lot can be obtained by purchase or condemnation for $10,000, and an appropriation of this amount for the purpose specified is recommended.

Protection of the inlet to the conduit at Great Falls.—The bank of the Chesapeake and Ohio Canal, which runs parallel to the Potomac at Great Falls, and about 150 feet from it, is about 14 feet higher than the uncovered chamber just above the Maryland end of the Aqueduct Dam that forms the inlet from the river to the conduit. In the flood of November, 1877, which rose at Great Falls to the height of 160 feet above the datum of the Aqueduct, or 12 feet higher than the crest of the dam, the canal bank at a point opposite the inlet was washed down to the river and a part of it into the inlet. I quote from the annual report of the Aqueduct for 1878:

"The masonary forming the arch of the feeder was uncovered from a point near the middle of the canal to the mouth of the feeder, a distance of 150 feet. The chamber at the head of the Aqueduct was filled with stones that had formed the slope wall of the canal, and the Aqueduct feeder for a distance of 300 feet was filled with débris to depths varying from 3 to 6 feet, so as to entirely stop the flow of water during the ordinary low stages of the river."

In the still higher flood of June, 1889, which rose to the height of 16 feet over the Aqueduct Dam, the canal bank was again washed down to the river, but fortunately the damage did not occur immediately opposite the inlet to the conduit, but from 200 to 400 feet higher up, so that the major part of the débris being left on the margin of the river and a part of it being carried over the dam, not so much filling of the inlet to the conduit was done, but, as in the flood of 1877, it was partially obstructed.

The annual report of the Aqueduct for 1889, says:

"The banks of the Chesapeake and Ohio Canal above and below the mouth of the conduit were carried away and that opposite the conduit was threatened. A number of men were kept at work on this bank during the freshet, and it is believed that had it not been for the energetic work of this force and the widening and strengthening of the bank at this locality in April, great damage would have occurred at the mouth of the conduit."

It will be observed that in the freshet of 1877, not only the inlet chamber, but the conduit itself was filled with débris to a depth of from 3 to 6 feet for a distance of 300 feet in from its mouth, but, the water in the river being at a high stage, there was still waterway enough in the conduit above the débris to enable the supply to the city to be kept up. Had a complete closure of the mouth of the conduit occurred, with 12 to 16 feet of water over it, there would have been no possible way, with the torrent raging over the mouth, to remove the obstruction before the river subsided, and the water supply to the city would have been cut off.

There is no more important part of our system of water supply to be carefully guarded than the head of the conduit at Great Falls, and in order to avert dangers like those of 1877 and 1889, to which the water supply is liable at every freshet, a masonry wall should be built between the river and the canal, rising a few feet higher than the latter and extending up river from the mouth of the conduit as far as the limit of the Government land, and thence, at about a right angle, and still on the Government land, to the shore of the river. The estimated cost of this wall is $5,000.

Annual appropriation for operation, maintenance, and repair of the Aqueduct system.—Owing to the experience gained during the two preceding years, it is now known that it is entirely practicable to remove all deposits from the Aqueduct and to scrape and sweep the interior thoroughly once every year at comparatively small cost, and it is proposed to carry out this plan annually hereafter. In order to do this no increase over the regular annual appropriation of the preceding year is deemed necessary, and I therefore recommend the appropriation of $21,000 for the preservation, maintenance, and repair of the Washington Aqueduct, a sum which is but one-half of 1 per cent of the cost of the works.

APPROPRIATIONS AND DEPOSITS.

By act approved March 3, 1897 (Public—No. 129), there were appropriated for

Washington Aqueduct.

For engineering, maintenance, and general repairs	$21,000
For constructing new telephone line between office and Great Falls	5,000

A project for the expenditure of these appropriations was submitted on May 25, and approved by the Chief of Engineers on May 27, 1897. The work will be accomplished during the fiscal year commencing July 1, 1897.

By direction of the Secretary of War and to cover any damages to the property of the Aqueduct system, the following sums were deposited with the Treasurer of the United States to the credit of the Washington Aqueduct:

November 23, 1895, by Metropolitan Railroad Company	$500
June 12, 1896, by Capital Traction Company	500
June 19, 1896, by Glen Echo Railroad Company	500
June 22, 1896, by Washington and Great Falls Electric Railway Company	500

It has not been necessary to expend any of this money for the purposes contemplated, and by order of the Secretary of War the deposit made by the Glen Echo Railroad Company was returned to the company on May 25, 1897.

ESTIMATES.

The estimates of appropriations that should be made for the year ending June 30, 1899, are as follows:

For repairing the north connection of the by-conduit, Dalecarlia Reservoir	$3,000.00
For repairing the Conduit road	5,000.00
For resuming work upon the Washington Aqueduct tunnel and new reservoir and their accessories	805,850.30
For building combined storehouse and stable at Great Falls	3,000.00
For purchase or condemnation of a site for a storage yard	10,000.00
For protection of the inlet to the conduit at Great Falls	5,000.00
For operation, maintenance, repair, etc., of the Aqueduct and its accessories	21,000.00
Total	852,850.30

Money statements.

July 1, 1896, amount appropriated by act of June 11, 1896	$20,000.00
June 30, 1897, amount expended during fiscal year	19,338.92
July 1, 1897, balance unexpended	661.08
July 1, 1897, outstanding liabilities	618.35
July 1, 1897, balance available	42.73
Amount that can be profitably expended in fiscal year ending June 30, 1899	*852,850.30
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

WASHINGTON AQUEDUCT, DISTRICT OF COLUMBIA, 1897. INSERTING VALVES.

July 1, 1896, amount appropriated by act of June 11, 1896	$5,000.00
June 30, 1897, amount expended during fiscal year	4,758.68
July 1, 1897, balance unexpended	241.32

Appropriations made for the Washington Aqueduct, with the dates of acts for the same.

Date.	Amount.	Date.	Amount.	Date.	Amount.
September 30, 1850	$500	March 3, 1871	$114,196	February 25, 1885	$20,000
August 31, 1852 *a*	5,000	June 10, 1872	70,555	July 9, 1886	20,000
March 3, 1853	100,000	January 23, 1873	14,000	March 3, 1887	20,000
March 3, 1855	250,000	March 3, 1873 *c*	43,600	July 18, 1888 *h*	20,000
August 18, 1856	250,000	June 23, 1874 *d*	36,400	March 2, 1889 *i*	20,000
March 3, 1857	1,000,000	March 3, 1875	26,000	August 6, 1890 *j*	25,500
June 12, 1858	800,000	July 31, 1876	22,000	March 3, 1891 *k*	20,000
June 25, 1860	500,000	March 3, 1877	15,000	July 14, 1892	20,000
July 4, 1864	150,000	June 20, 1878	15,000	March 3, 1893	80,000
July 28, 1866	142,584	March 3, 1879 *e*	20,000	August 7, 1894 *m*	82,500
December 20, 1866	12,000	June 4, 1880 *f*	20,000	March 2, 1895 *n*	71,500
March 2, 1867	20,000	March 3, 1881	20,000	June 11, 1896 *o*	25,000
July 25, 1868	52,500	July 1, 1882 *g*	20,000	March 3, 1897	26,000
March 3, 1869	25,000	March 3, 1883	20,000		
July 15, 1870 *b*	120,822	July 5, 1884	20,000	Total	4,355,657

NOTE.—Reverted to the Treasury: (*a*) $2.81, (*b*) $46.25, (*c*) $560.87, (*d*) 35 cents, (*e*) $1,109.87, (*f*) $381.06, (*g*) $1,354.17, (*h*) $2,266.34, (*i*) $4.12, (*j*) $5,500, (*k*) $2.49, (*m*) $39.96, (*n*) $2,983.87, (*o*) $285.85, total, $14,531.08. Since 1878 one-half of the amounts appropriated has been contributed by the United States and the other half by the District of Columbia.

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* $805,850.30 of this amount is for resuming work upon the Washington Aqueduct tunnel and new reservoir and their accessories.

Including the amount actually spent on the uncompleted W Aqueduct tunnel and the new reservoir near Howard Unive total amount expended for the construction, operation, and mai of the Aqueduct and all accessory works up to June 30, $6,490,710.51, of which amount the District of Columbia $1,292,320.25.

Respectfully submitted.

D. D. GAILLAR
Captain, Corps of En

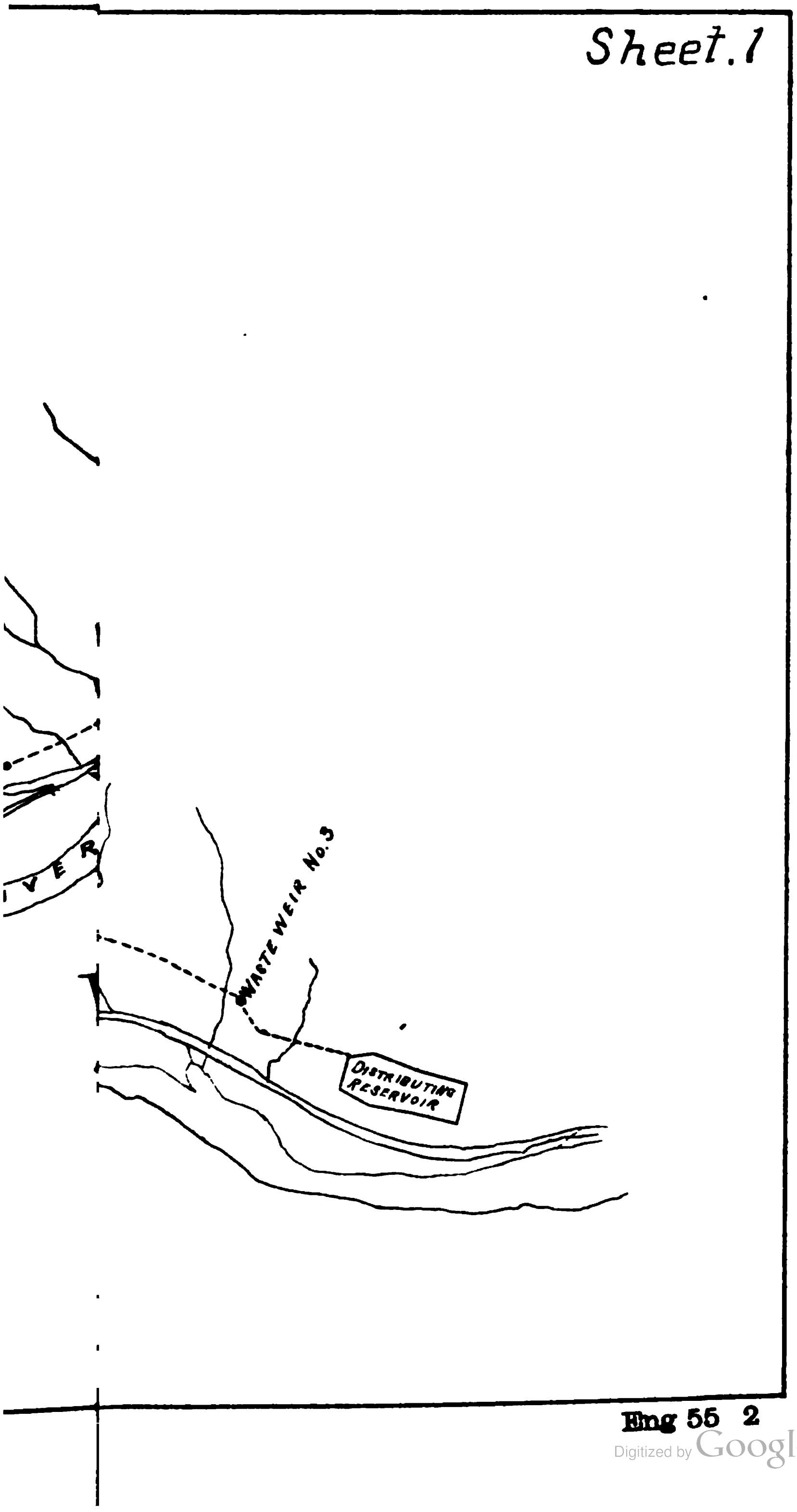
APPENDIX 1.

CONDITION OF THE WATER DURING THE YEAR.

Condition of water at Great Falls, Dalecarlia Reservoir, and distributin and height of water over dam at Great Falls for each day in the year. from 0 for extremely muddy water to 36 for perfectly clear.

[As the work of raising the height of the dam was in progress from the beginnin year to November 25, 1896, no heights of water are given for that time.

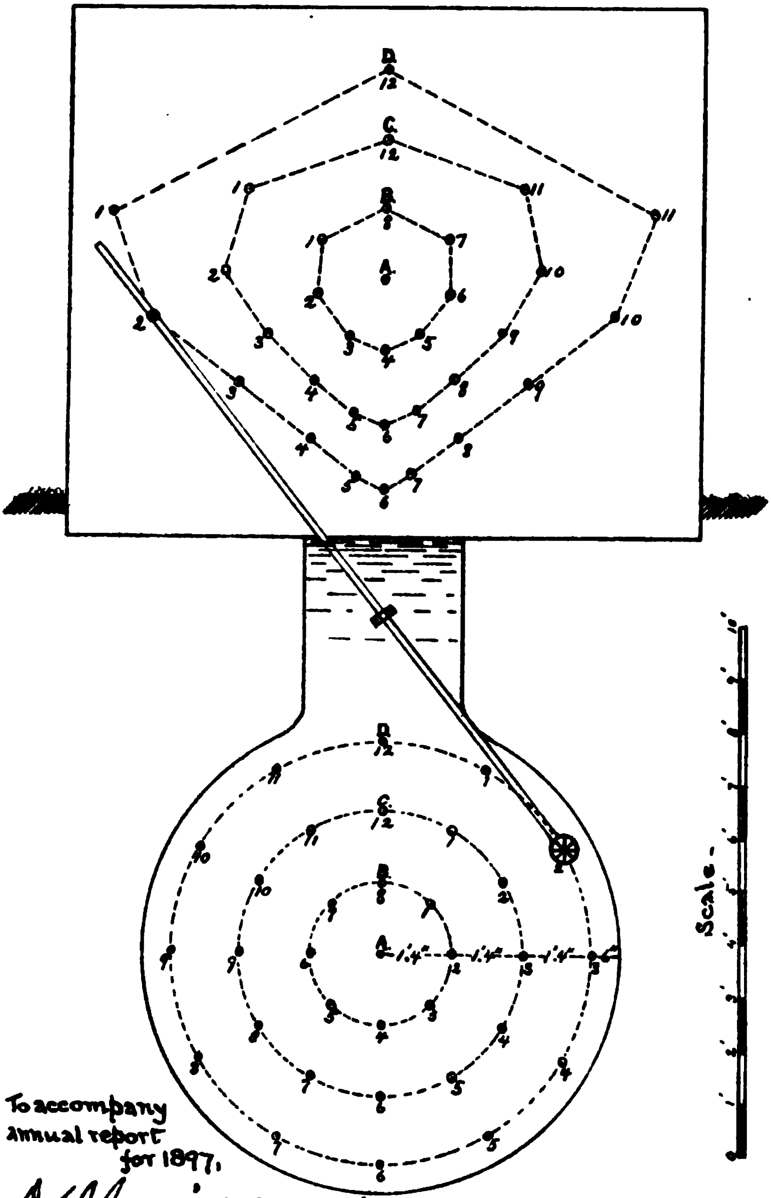
Day of month.	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condi wa	
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving res- ervoir, sout
	July, 1896.				August, 1896.				September, 1896.				Oct	
1	4	4	12	Dam being raised from reference 148 to 150.5.	9	8	5	Dam being raised from reference 148 to 150.5.	36	36	36	Dam being raised from reference 148 to 150.5.	1	[illegible]
2	7	7	9		5	7	7		36	36	36		1	[illegible]
3	8	9	10		7	14	9		36	36	36		1	[illegible]
4	12	11	16		5	17	11		24	36	36		1	[illegible]
5	25	18	18		19	24	14		36	36	36		1	[illegible]
6	28	18	27		25	29	20		18	36	36		2	[illegible]
7	2	28	29		30	31	29		36	36	36		2	[illegible]
8	1	6	36		32	36	36		36	36	36		3	[illegible]
9	1	3	27		27	36	36		36	36	36		3	[illegible]
10	1	8	20		36	36	36		36	36	36		4	[illegible]
11	1	5	14		36	36	36		36	36	36		4	[illegible]
12	2	6	14		36	36	36		36	36	36		4	[illegible]
13	2	7	13		36	36	36		36	36	36		14	8
14	3	4	7		36	36	36		36	36	36		15	10
15	2	5	7		36	36	36		36	36	36		20	11
16	1	8	13		36	36	36		36	36	36		22	15
17	2	3	13		36	36	36		32	36	36		30	19
18	3	3	9		36	36	36		36	36	36		32	21
19	4	4	7		16	36	36		36	36	36		36	28
20	4	7	7		25	36	36		10	36	36		36	34
21	8	12	7		36	36	36		25	36	36		36	36
22	10	16	10		36	36	36		36	36	36		36	36
23	26	20	12		36	36	36		36	36	36		36	36
24	1	24	12		36	36	36		36	36	36		36	36
25	1	9	25		11	36	36		36	36	36		36	36
26	1	3	18		26	36	36		36	36	36		36	36
27	1	2	10		36	36	36		36	36	36		36	36
28	1	2	7		36	36	36		36	36	36		36	36
29	2	3	6		36	36	36		36	36	36		36	36
30	3	3	5		36	36	36		22	36	36		36	36
31	3	5	5		36	36	36		......	......	......		36	36



Eng 55 2

Sheet 2.

Sketch showing method of using current meter in gauging Washington Aqueduct, 1896-7.

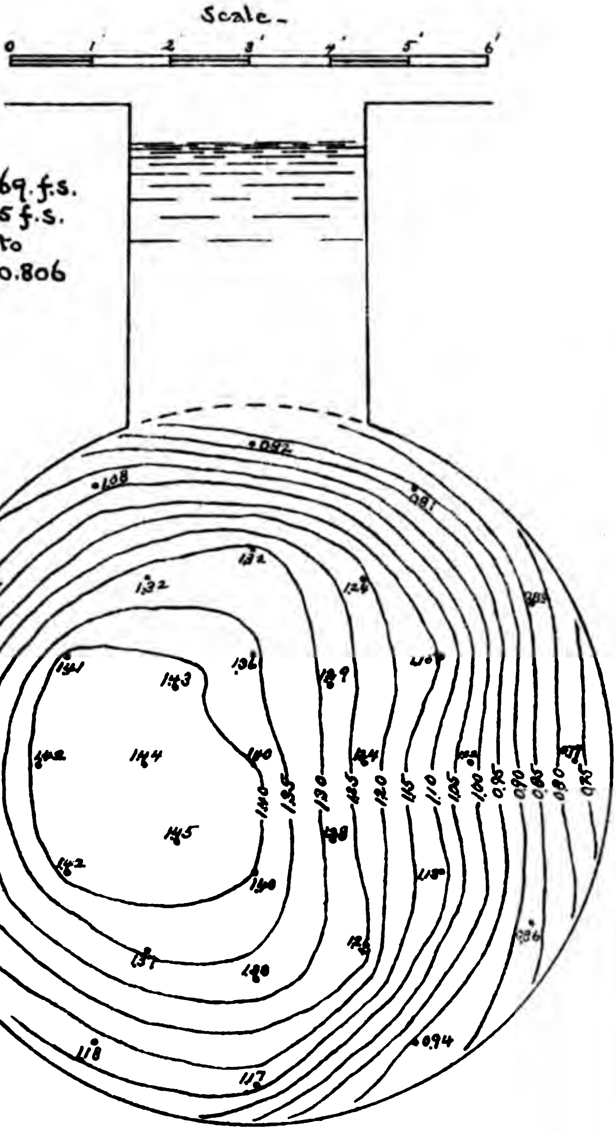


To accompany
annual report
for 1897.

D. D. Gaillard
Captain, Corps of Engineers.

Sheet 3.

Curves showing velocity in conduit at Gauging Station No. 1. August 25, 1896.



Mean Vel. = 1.169. f.s.
Max. Vel. = 1.45 f.s.
Ratio Mean to
Max. Vel. = 0.806
R = 2.'25
C = 104.1

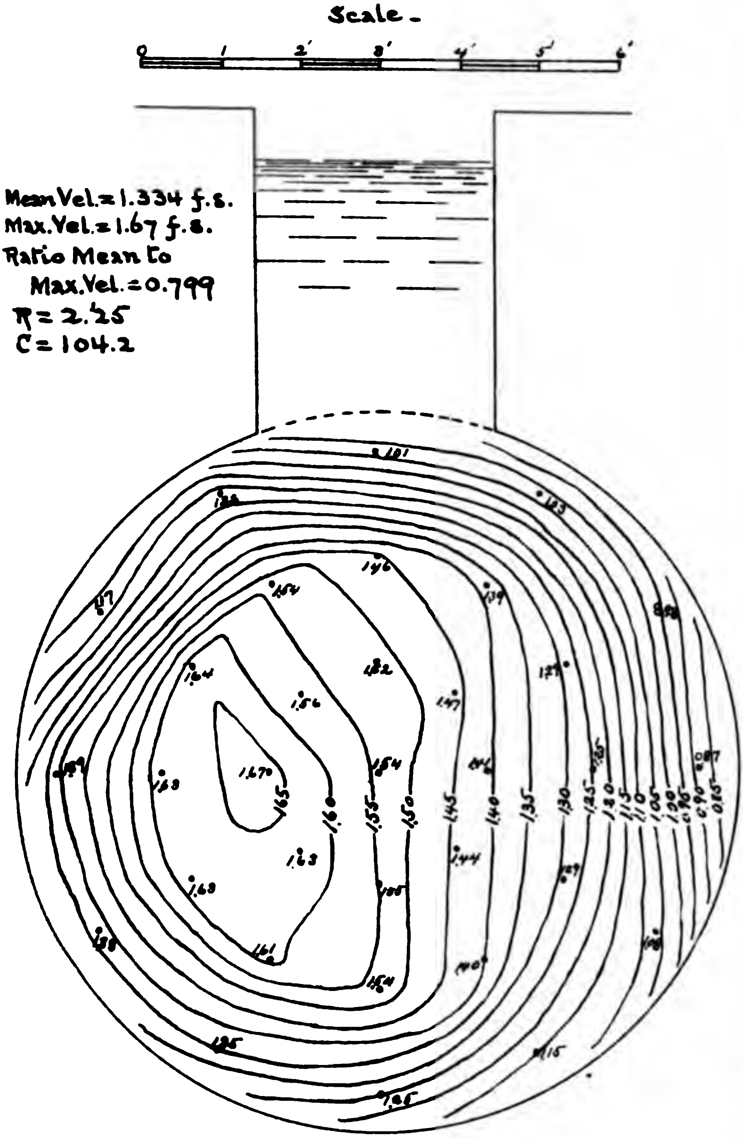
To accompany annual report for 1897.

D. D. Gaillard,
Captain, Corps of Engineers.

Sheet 4.

Curves showing velocity in conduit at Gauging Station No. 1. September 24, 1896.

Scale.



Mean Vel. = 1.334 f. s.
Max. Vel. = 1.67 f. s.
Ratio Mean to
Max. Vel. = 0.799
R = 2.25
C = 104.2

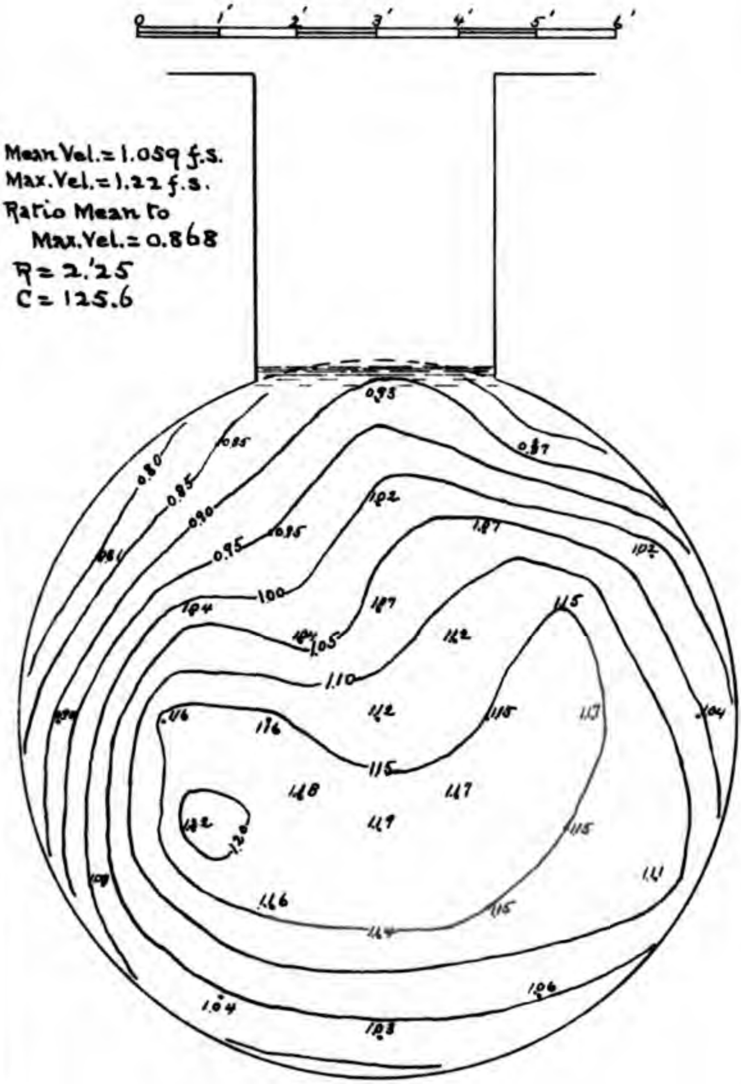
To accompany annual report for 1897,

D. D. Gaillard,
Captain, Corps of Engineers.

Sheet 5.

Curves showing velocity in conduit at Gauging Station No. 2. June 14, 1897.

Scale.



Mean Vel. = 1.059 f.s.
Max. Vel. = 1.22 f.s.
Ratio Mean to Max. Vel. = 0.868
R = 2.'25
C = 125.6

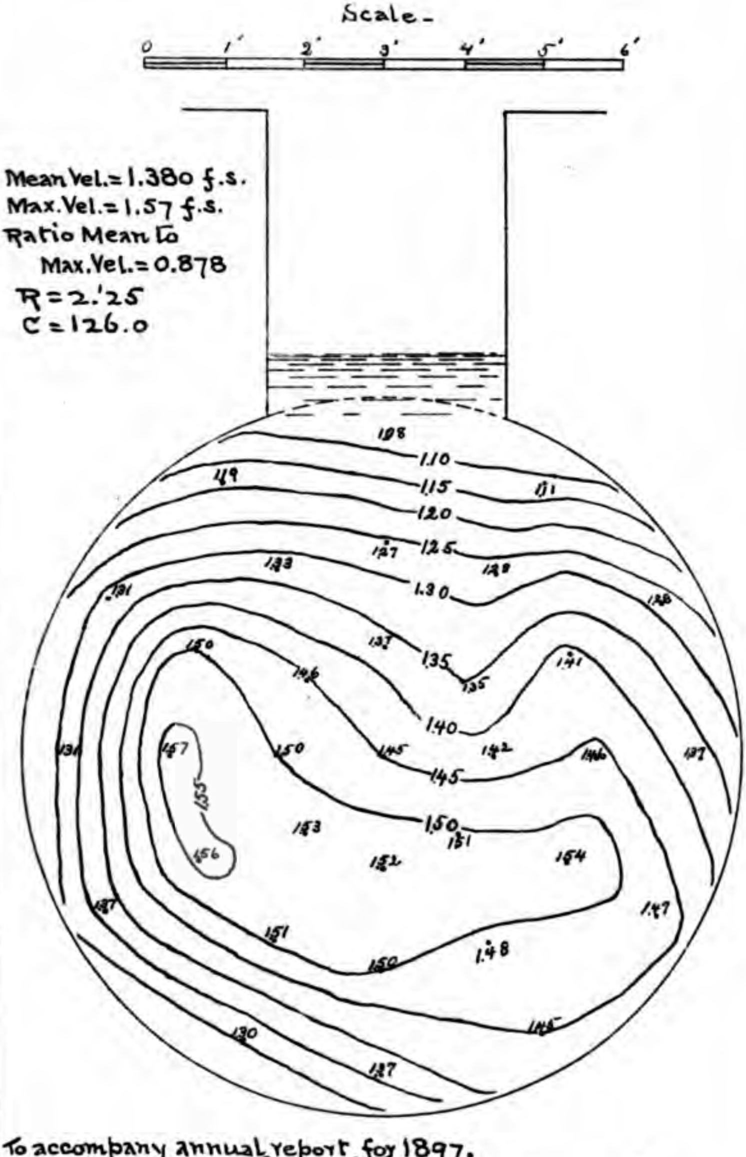
To accompany annual report for 1897,

D. D. Gaillard,
Captain, Corps of Engineers.

Eng 55 2

Sheet 6.

Curves showing velocity in conduit at Gauging Station No. 2. June 10, 1897.



Mean Vel. = 1.380 f.s.
Max. Vel. = 1.57 f.s.
Ratio Mean to Max. Vel. = 0.878
R = 2.'25
C = 126.0

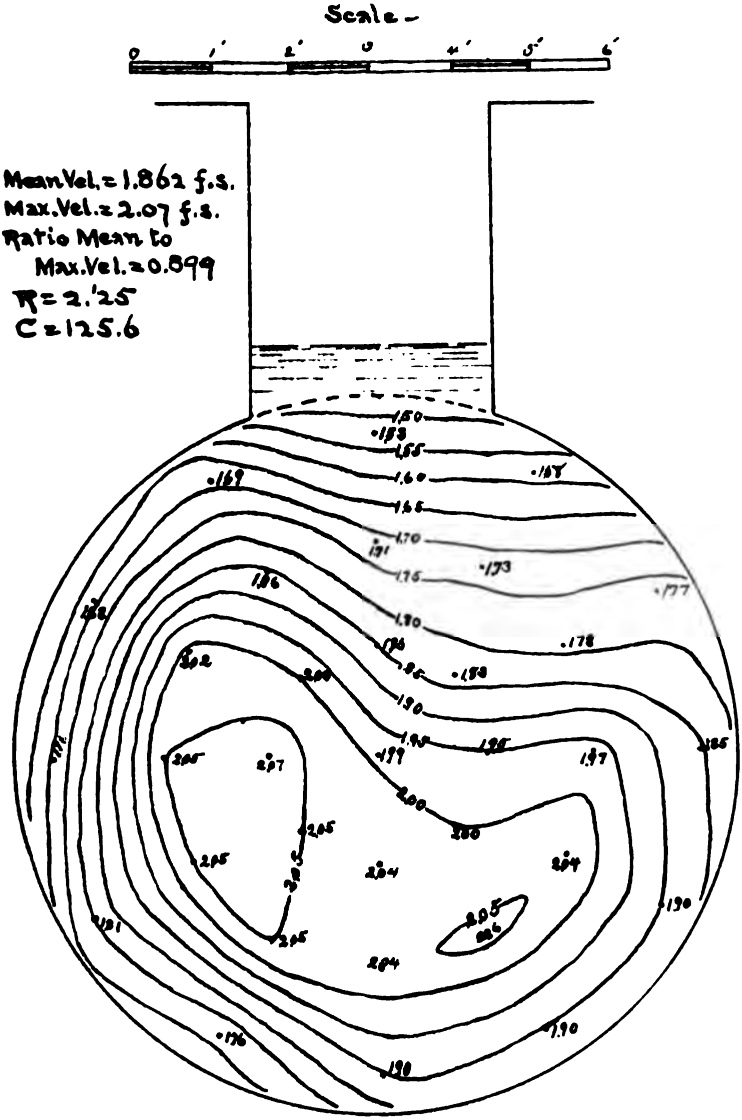
To accompany annual report for 1897.

D. D. Gaillard,
Captain, Corps of Engineers.

Eng 55 2

Sheet 7.

Curves showing velocity in conduit at Gauging Station No. 2. July 8, 1897.



Mean Vel. = 1.862 f.s.
Max. Vel. = 2.07 f.s.
Ratio Mean to
Max. Vel. = 0.899
R = 2.'25
C = 125.6

To accompany annual report for 1897,

D. D. Gaillard,
Captain, Corps of Engineers.

Condition of water at Great Falls, Dalecarlia Reservoir, etc.—**Continued.**

Day of month.	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.	
	November, 1896.				December, 1896.				January, 1897.				February, 1897.			
1	36	36	36	Dam being raised from reference 148 to 150.5.	16	36	36	.90	36	36	36	.80	36	36	36	.70
2	36	36	36		16	32	36	1.30	36	36	36	.80	36	36	36	.70
3	36	36	36		18	27	36	1.40	36	36	36	.80	1	36	36	1.20
4	36	36	36		32	32	36	1.30	36	36	36	.80	1	13	36	1.30
5	36	36	36		29	36	36	1.20	36	36	36	.80	1	3	25	1.10
6	36	36	36		36	36	36	1.10	36	36	36	.80	2	2	18	1.10
7	6	36	36		36	36	36	1.00	36	36	36	.80	1	2	6	3.10
8	2	36	36		36	36	36	1.00	36	36	36	1.00	1	2	4	3.70
9	4	23	36		36	36	36	1.00	36	36	36	1.00	1	2	2	2.90
10	6	7	36		36	36	36	1.00	36	36	36	1.00	1	1	2	2.40
11	10	4	36		36	36	36	1.00	36	36	36	.90	2	2	2	1.90
12	11	6	36		36	36	36	1.00	36	36	36	.80	2	2	2	1.80
13	16	12	36		36	36	36	1.00	36	36	36	.80	2	3	2	1.70
14	30	18	36		36	36	36	1.00	36	36	36	.80	5	3	3	1.70
15	28	24	36		36	36	36	1.00	36	36	36	.80	4	5	3	1.90
16	29	29	36		36	36	36	1.00	36	36	36	.80	4	7	3	2.10
17	34	36	36		36	36	36	.90	36	36	36	.80	2	10	3	2.40
18	36	36	36		36	36	36	.90	36	36	36	.80	2	6	3	2.50
19	36	36	36		36	36	36	.90	36	36	36	.80	3	4	3	2.40
20	36	36	36		36	36	36	.90	36	36	36	.80	3	4	4	2.40
21	36	36	36		36	36	36	.90	36	36	36	.90	3	5	4	2.30
22	36	36	36		36	36	36	.90	36	36	36	1.10	1	4	5	2.40
23	36	36	36		36	36	36	.90	36	36	36	1.00	1	6	5	4.50
24	36	36	36		36	36	36	1.10	8	36	36	.90	1	4	4	6.10
25	36	36	36		36	36	36	.90	14	8	36	1.00	1	3	3	5.50
26	36	36	36	.80	36	36	36	.70	24	14	36	.80	1	2	4	3.30
27	36	36	36	.80	36	36	36	.70	24	18	36	.70	1	1	3	2.50
28	36	36	36	.80	36	36	36	.70	28	26	30	.70	1	1	2	2.20
29	36	36	36	.90	36	36	36	.70	30	31	30	.70	.....	......	......	......
30	8	36	36	.90	36	36	36	.80	36	36	36	.70	.....	......	......	......
31	.....	......	......	......	36	36	36	.80	36	36	36	.70	.....	......	......	......

Condition of water at Great Falls, Dalecarlia Reservoir, etc.—Continued.

Day of month.	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.	
	March, 1897.				April, 1897.				May, 1897.				June, 1897.			
1	2	2	2	1.90	25	10	12	1.30	36	36	36	.90	19	10	9	1.
2	4	2	2	1.70	28	16	17	1.20	36	36	36	.90	26	11	9	1.
3	7	2	2	1.60	31	21	20	1.10	36	36	36	1.00	14	8	10	.
4	9	3	2	1.60	33	26	23	1.10	1	36	36	4.20	2	7	10	.
5	7	3	3	1.60	13	36	28	1.10	1	36	36	3.20	8	3	12	.
6	6	4	3	1.80	16	32	33	1.20	1	17	36	2.50	10	24	15	1.
7	4	9	3	2.00	7	20	36	1.20	4	5	36	2.10	3	5	18	1.
8	4	4	4	2.00	12	23	36	1.30	7	3	36	1.80	2	5	20	.
9	4	5	4	1.90	12	11	36	1.30	13	3	23	1.60	3	3	16	1.
10	6	5	5	1.70	7	26	36	1.40	14	4	16	1.40	5	2	14	1.
11	6	4	6	1.70	3	22	36	2.00	24	8	16	1.40	7	5	11	.
12	4	5	6	1.60	3	16	36	1.90	16	12	18	1.40	11	5	11	.
13	13	6	6	1.50	5	9	36	1.60	13	13	18	1.30	20	6	11	.
14	14	7	7	1.50	8	5	36	1.50	1	3	20	2.30	22	12	11	.
15	8	8	9	1.50	16	6	29	1.40	1	2	5	3.70	25	20	10	.
16	15	9	10	1.50	16	7	30	1.40	1	1	7	3.10	22	26	16	.
17	21	14	13	1.50	27	19	30	1.40	2	1	5	2.40	30	36	20	.
18	12	12	13	1.50	24	24	26	1.40	4	1	5	2.00	24	36	24	.
19	7	15	15	1.60	33	27	30	1.30	7	2	4	1.70	26	30	30	.
20	6	18	21	1.80	33	30	33	1.30	9	3	4	1.60	31	36	36	.
21	2	4	25	2.10	35	27	36	1.20	11	5	4	1.50	30	36	36	.
22	4	12	28	2.20	36	21	36	1.20	13	5	5	1.40	20	36	36	1.
23	4	5	28	2.00	36	36	36	1.10	22	5	5	1.30	20	30	36	.
24	6	4	18	1.80	36	36	36	1.10	5	6	7	1.30	23	36	36	.
25	6	5	15	1.80	36	36	36	1.00	1	18	8	1.40	3	36	36	.
26	5	6	14	1.80	36	36	36	1.00	1	3	11	1.40	24	32	36	.
27	5	7	13	1.60	36	36	36	1.00	1	1	9	1.80	32	25	36	.
28	4	5	13	1.50	36	36	36	.90	1	2	8	1.20	36	36	36	.
29	12	6	18	1.40	36	36	36	.90	7	3	8	1.10	36	36	36	.
30	14	6	13	1.30	36	36	36	.90	9	4	8	1.00	36	36	36	.
31	22	10	12	1.30	......	......	......	......	14	5	9	1.00	......	......	......	......

Daily gauge pressures at the office of the Washington Aqueduct at 9 o'clock a. m.

Month.	Main.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	Average.
1896.	*Inch.*																																
July	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	35	35	35	35	36	36	36	36	36	36	36	36	36	36	36	36	35	35	35	36	36	36	36	36	36	36	36	36	36	36	36	35.77
August	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	36	36	35	35	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	35.93
September	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	21	31	31	31	31	31	31	31	31	31	31	....	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	48	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	37	37	37	37	37	....	36.16
October	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	36	37	37	37	37	37	36.96
November	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	48	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	....	37
December	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	36	36	36	36	36	36	36	36	36.74
1897.																																	
January	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	(*a*)	30	30	30	30	30	30.83
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	30	30	30	30	30.80
	48	36	37	37	37	37	37	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	35	35	35	34	34	34	35.87
February	30	30	30	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	....	....	30.82
	36	30	30	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	....	....	30.82
	48	34	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	36	36	36	36	36	36	36	36	36	36	36	....	....	....	35.35
March	30	30	30	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30.83
	36	30	30	31	31	31	31	31	32	31	31	31	31	32	32	32	32	32	32	32	32	32	32	32	32	32	32	31	32	32	32	32	31.54
	48	36	36	35	35	35	35	35	36	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	36.58
April	30	31	31	31	31	31	31	31	31	31	30	30	30	30	30	30	30	30	30	28	32	31	31	31	31	31	30	30	30	30	30	....	30.13
	36	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	33	32	33	32	32	32	32	32	32	32	32	30	30	....	31.90
	48	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	....	37
May	30	30	30	30	30	30	30	30	30	31	31	31	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30.10
	36	32	32	32	32	31	31	31	31	32	32	32	31	30	31	31	31	31	32	32	32	32	32	32	32	34	33	33	32	32	32	32	31.77
	48	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37
June	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	....	30
	36	32	32	32	32	32	32	32	33	33	33	32	32	32	32	32	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31.53
	48	37	37	37	36	37	37	37	37	37	37	37	37	37	37	37	36	36	36	37	37	37	37	37	37	37	37	37	37	37	37	....	36.86

a Gauge pipe frozen.

A A A 2.

INCREASING THE WATER SUPPLY OF WASHINGTON, DISTRICT OF COLUMBIA.

This work was commenced under an appropriation made by act of Congress approved July 15, 1882.

The plan consisted in raising the dam in the Maryland channel at the Great Falls of the Potomac to an elevation of 148 feet above mean tide at the Washington Navy-yard and its extension at that height across Conns Island and the Virginia channel of the river; extending the Washington Aqueduct from the distributing reservoir above Georgetown to the site selected for the new reservoir near Howard University by a tunnel 20,696.3 feet long; constructing at the tunnel outlet a new reservoir of about 300,000,000 gallons capacity, and connecting this reservoir by a new line of large mains with the existing system of water mains in the city of Washington.

So much of the plan as related to raising and extending the dam at Great Falls was completed during the fiscal year 1887. No operations under the project were carried on during the past fiscal year.

A watchman has been employed during the year at the new reservoir. His duties have included guarding the stone at the mouth of all shafts except the one at Foundry Branch, which is under the care of the watchman at the distributing reservoir.

The following is a list of the appropriations for this work, with the date of act for the same:

July 15, 1882	$1,485,279.[illegible]
July 7, 1884	87,500.00
March 3, 1885	87,500.00
March 26, 1886	5,000.00
August 4, 1886	555,000.00
March 30, 1888	355,000.00
Total	2,575,279.[illegible]

The act of Congress approved March 2, 1895, making appropriations for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1896, and for other purposes, contained the following:

> For raising the height of the dam at Great Falls, together with the cost of such other work as may be found necessary in connection therewith, including the cost of strengthening the conduit, and for damages on account of flooding of land, and other damages, one hundred and twenty-five thousand dollars, for which amount and purposes the available balance of the appropriation for increasing the water supply of the city of Washington shall be applicable, subject to all the provisions and restrictions of the act to increase the water supply of the city of Washington, and for other purposes, approved July fifteenth, eighteen hundred and eighty-two, and of the act approved July fifth, eighteen hundred and eighty-four, making appropriations for the expenses of the government of the District of Columbia as to apportionment and settlement between the United States and the District of Columbia, and the refunding thereof. * * *

RAISING THE HEIGHT OF THE DAM AT GREAT FALLS.

This dam extended from the Virginia to the Maryland shore, crossing Conns Island. Its total length was 2,877 feet. The width of its crest in the Maryland channel was 7 feet 9 inches, and across Conns Island and in the Virginia channel 8 feet 3 inches. The reference of the crest was 148 feet above datum. (For details, see Sheet A.)

During periods of extreme low water in the Potomac River the reference of the surface of the water at the mouth of the conduit feeder was but 148.5 feet, while that of the interior of the crown of the conduit itself, if produced to the gatehouse, is 151 feet; consequently at this stage the surface of the river was 2.5 feet below the crown of the 9-foot conduit produced, and the capacity of the conduit was much decreased thereby.

It was therefore proposed to raise the height of the dam from a reference of 148 feet to 150.5 feet, so that at its lowest stage the river would fill the upper part of the 9-foot section of the conduit.

The approved project was to remove the coping stones, raise the height of the dam the desired amount, replace the coping stones, securing them in place by iron bolts and clamps, and strengthen the conduit to withstand the increased pressure caused by raising the dam.

The dam was slightly out of level, and it was proposed to correct this as much as practicable while raising the dam, so that when completed its crest would be practically at a uniform height throughout.

The project contemplated obtaining all of the stone from the Government quarry at Seneca, Md., which was reopened on March 21, 1895. Quarrying was continued there until December 14, 1895, when it was decided that the depth of "stripping" then necessary (over 30 feet) precluded all idea of obtaining stone from that source economically. Six hundred and fifty-one cubic yards of dimension stone and 17 cubic yards of coping had been quarried at Seneca.

On January 21, 1896, authority was granted by the Chief of Engineers to obtain stone by contract, and after due advertisement the bid of Mr. Asa B. Cook, of Petersburg, Va., for furnishing about 1,100 cubic yards of dimension stone (granite) at $18 per cubic yard, and about 100 cubic yards of coping (granite) at $27 per cubic yard, was accepted, and the contract approved by the Chief of Engineers on March 28, 1896. Time of commencement of contract, April 10, 1896; time of completion, July 1, 1896, extended by authority of the Chief of Engineers to September 15, 1896, and further extended to November 15, 1896. Completed November 7, 1896.

The total length of dam raised was 2,751.1 linear feet, the plan and cross section being as shown on the accompanying tracing, Sheet A.

The first stone was laid on September 30, 1895, and the last stone on November 25, 1896, work having been suspended on account of cold weather from December 14, 1895, to March 23, 1896.

During the working period there were, excluding only Sundays and national holidays, 283 working days, out of which there were lost,

	Days.
On account of high water in the Potomac River	84
For want of stone from contractor	23
	107

Leaving 176 days on which it was possible to work when weather overhead permitted.

The velocity of the water on the crest of the dam was very great, and it was known in advance that whatever the form of cofferdam used, it would be exposed on the upstream side to the pressure due to a head of from 3 to 5 feet. Moreover, the Potomac is subject to large and sudden rises during the working season, and on such occasions carries much driftwood.

After a study of the various conditions affecting the problem, it seemed probable that the best results would be obtained by a cofferdam which would protect the workmen and inclose only so much of the dam as could be raised in a single working day, and, after the concrete and mortar had set, could be taken up and used elsewhere.

The proposed plan, with slight modifications to suit the three different cases, was adopted, and proved very efficient and economical. Against a head of from 3 to 5 feet practically no leakage was developed through any of the joints of the three 15-inch courses of masonry laid with the use of the cofferdam. In view of its small cost and great efficiency, it is believed that a detailed description of the cofferdam, the method of using it, and a statement of its cost will not be without interest.

Description of the cofferdam used in raising the height of the United States dam at Great Falls, Md. (See tracing, Sheet B.)—This cofferdam consists of two horizontal movable wooden bulkheads A B C D, each 30 feet long; the 1½-inch round iron bars E E, for holding them in position and resisting the pressure of the water, and the sandbag dams F G and H K, for closing the ends. The bulkheads were made by fastening together five 2 by 12-inch by 30-foot Georgia pine planks with three 2 by 12-inch cleats L L L and 40-penny nails. The joints between the boards were then carefully calked with jute. Each bulkhead was also provided with 2 ringbolts M M, so that it could be handled either with the derrick or suspension cable way. After the riprap stone N N N had been placed to shut off a portion of the water, and the old coping had been removed, holes were drilled in the old masonry for the 1½-inch iron bars at the angle shown in the section. These holes were put in to a depth of 24 inches, and just inside the upstream building line, so that the bulkheads would rest on the old masonry—which is the same width as the new. The bulkheads were then put in position, and the joint C D between them and the old masonry having been calked with pieces of old bags, and the sandbag dams F G and H K having been built, the cofferdam was ready for use. By the use of an additional row of sandbags on the inside of the cofferdam the headers and stretchers in the bottom course of the downstream face of the new masonry were laid on a bed free from leakage. These sandbags were then removed and the headers and stretchers in the bottom course of the upstream face of the new masonry were laid in water an inch or two deep, but having practically no current. All the new masonry above the bottom course was laid on a bed entirely free from leakage. This style of cofferdam was used in raising the height of the dam in the Maryland channel for a distance of 460 feet after the weather became too cold for the laborers to go into the water. It does not allow the use of any stones in the upstream face of the bottom course that have quarry faces extending beyond the building line, and it requires the spawling of stones at each 1½-inch iron bar so as to get the proper width of dam.

In the Maryland channel, until the water became too cold for laborers to enter it with impunity, the bottom of the bulkhead was kept about 6 inches from the upstream face of the dam by means of two figure-8-shaped iron braces, through one of the loops of which passed the iron bars E E, while through the other loop passed a similar iron bar, against which the bulkhead rested.

A row of sandbags was carefully placed so that they would be a little below the top of the old masonry and would make a tight joint with it. On top of this row of sandbags the wooden bulkheads were placed, so as to leave between them and the new masonry sufficient space for the passage of the slight leakage through the cofferdam.

This allowed the use, in the upstream face of the bottom course, of stones having quarry faces projecting several inches beyond the building line. Back of the bulkheads, and partly covering the row of sandbags on which they rested, was placed another row of sandbags.

The cofferdam being fixed, the other operations were similar to those described in the first case.

In the Virginia channel there was a 6-inch offset below the third course of masonry (see cross section, Sheet A), and the holes for the round iron bars E E were drilled in this offset 4 inches above the upstream face of the new masonry and to a depth of about 12 inches. The bottom of the bulkhead then rested on the comparatively smooth upper surface of the offset, and the space between the bulkhead and the upstream face of the masonry provided a passage for the escape of the slight leakage through the cofferdam, as in the second case. After the cofferdam was fixed, the other operations were identical with those described in the first case.

The masonry in the portion of the dam across the Virginia channel was much superior to that in the part across the Maryland channel (see cross sections, Sheet A). Owing to this fact and to the existence of the offset already described, operations on this part of the dam were much simplified.

The cofferdam just described was successfully used for raising 2,095 linear feet of dam in the Virginia and Maryland channels, the 656 linear feet across Conns Island requiring no cofferdam.

The entire cost of the cofferdam (wooden bulkheads and sand-bag dams), including all operations connected with setting and calking it, was as follows:

Superintendence	$184.00
Materials	322.06
Labor	1,558.00
Total	2,064.06

Two thousand three hundred and fifty-two cubic yards of stone and concrete were laid behind the cofferdam, which therefore added 88 cents per cubic yard to the cost of these items. As the cofferdam was used for a distance of 2,095 feet, its average cost per linear foot was 98½ cents.

To strengthen the conduit against the increased pressure which might be developed on account of raising the dam, the embankments in which the conduit rests were widened, as shown in the following table:

Location.	Side widened.	Feet of embankment widened.	Length of embankment widened.	Material used.
			Feet.	*Cu. yds.*
Between wasteweir 1 and manhole 4	West	4	675	500
Culvert 1	West	5	270	225
Between culverts 2 and 3	West	5	495	367
Culvert 4	East	8	135	280
Do	West	7	150	136
Culvert 5	West	7	140	163
Culvert 7	West	7	410	451
Culvert 8	East	6	80	106
Between culverts 8 and 9	West	4½	486	243
Culvert 9	East	3	130	72
Do	West	5	300	388
Culvert 10	East	4	585	390
Do	West	5	556	618
Culvert 12	East	5	285	238
Do	West	5	300	250
Culvert 17	East	3½	230	163
Do	West	3½	228	133
Total			5,455	4,728

This completed the work of strengthening the embankments and makes a total of 9,870 cubic yards of materials used for this purpose. Of this amount, 5,147 cubic yards were put in place during the fiscal year ending June 30, 1896, of which 3,480 cubic yards were charged to the annual appropriation for preservation, maintenance, and repair of the Washington Aqueduct, and 1,667 cubic yards to the appropriati for raising the dam and strengthening the conduit.

On July 29, 1895, Mr. John K. Cowen, president of the trustees of t Chesapeake and Ohio Canal, addressed a letter to the Secretary of W asking that the trustees of the Chesapeake and Ohio Canal be given hearing before any final instructions were given in regard to raising t dam at Great Falls.

This communication was referred to the Chief of Engineers, who, August 2, recommended that "an officer of the Corps of Engineers designated to meet an engineer to be selected by the canal authoriti to form a commission to report on this question between the Unit States and the canal at once. If this recommendation be approv Maj. H. M. Adams, Corps of Engineers, is suggested to act for the Unit States."

This recommendation of the Chief of Engineers was approved by Secretary of War on August 5, 1895, and Mr. Cowen was notified ther by letter from the Secretary of War, dated August 6, 1895.

By letter of August 7, 1895, to the Secretary of War, Mr. Cowen sta that the trustees of the Chesapeake and Ohio Canal designated Mr. L. Nicolson, general manager, to meet Maj. H. M. Adams, as sugges in the recommendation of the Chief of Engineers.

The two commissioners after several meetings recommended "that canal authorities release the United States from all claims for dama to the canal embankment and towpath by reason of raising the da feet as authorized by act of March 2, 1895, and that the United St pay the estimated cost of the protection, $15,000; the work of rai the dam to be proceeded with at once."

By indorsement of the Secretary of War, dated September 7, 1 the Attorney-General of the United States was requested to give opinion as to whether the amount could be paid as recommended by commission in their report of August 16, 1895.

By letter dated September 14, 1895, the Attorney-General of United States stated that he was of the opinion that the Departm was authorized to pay the $15,000 as recommended by the commis and the Chief of Engineers from the money appropriated by the of March 2, 1895.

In view of this opinion, the payment of this sum as recomme was authorized by the Secretary of War by indorsement of Septe 23, 1895.

On September 26, 1895, the officer in charge of the Washin Aqueduct notified the general manager of the Chesapeake and Canal Company that he was authorized to pay the company $15 upon the condition that the canal authorities should release the U States from all claims for damages to the canal embankment and path by reason of raising the dam 2½ feet, as authorized by a March 2, 1895, and requested that the trustees of the company exe an inclosed release to this effect and formally authorize one of number or the general manager to receive the sum of $15,000, and such release and written authority be transmitted to this office, ac panied by evidence of the authority of the trustees of the canal pany to act in matters relating to the canal.

On September 27, 1895, the general manager of the canal com stated that the matter had been referred to the trustees.

On February 13, 1897, the proper release and vouchers having signed by the trustees, the award of $15,000 was paid to the c company.

The following table embraces the total expenditures from the ap

priation for raising the dam and strengthening the conduit. There are no known outstanding liabilities.

Table showing amount of materials and cost of various items connected with the work of raising the United States dam at Great Falls, Md., and strengthening the conduit against increased pressure which may be caused thereby.

Items.	Total amount of work of each class.	Total cost of work of each class.	Cost per cubic yard.	Cost per bolt or clamp.
Plant		a$13,691.29		
Superintendence and office expenses		7,273.50		
Cut stone quarried and purchased ... cubic yards	1,685.44	38,486.96	$22.84	
Cut stone laid ... do	1,669.04	5,165.49	3.10	
Coping:				
Quarried and purchased ... do	105.54	3,182.93	30.16	
Taken up from dam ... do	1,025.77	2,288.50	2.23	
Reset ... do	1,045.54	1,629.10	1.56	
Concrete in place ... do	350.46	2,043.46	5.83	
Riprap revetment in place ... do	5,108	6,621.68	1.29	
Five-foot anchor bolts in place	1,308	2,890.01		$2.21
Clamps in place	1,307	1,881.98		1.44
Strengthening conduit, earth placed ... cubic yards	6,390	1,217.89	.19	
Award paid Chesapeake and Ohio Canal Company, February 13, 1897		15,000.00		
Total		101,372.79		

a This includes $10,245 paid for the suspension cableway.

The total amount appropriated by the act of March 2, 1895, for "raising the dam at Great Falls" and strengthening the conduit was	$125,000.00
Amount expended as per preceding table	101,372.79
Balance	23,627.21

A recent careful inspection shows that since completion the dam has suffered no injury whatever either from the heavy ice of the past winter or from freshets, one of which, that of February 24, 1897, was the highest recorded since June, 1889.

In concluding this report I beg to acknowledge my great indebtedness to Mr. F. W. Johnston, assistant engineer in local charge of the work, not only for his intelligent supervision of the work, but also for his great ingenuity in successfully overcoming the many difficulties arising in work of this character.

Money statements.

RAISING THE HEIGHT OF THE DAM AT GREAT FALLS.

July 1, 1896, balance unexpended	$72,734.19
June 30, 1897, amount expended during fiscal year	49,106.98
July 1, 1897, balance unexpended	23,627.21

INCREASING THE WATER SUPPLY OF WASHINGTON, D. C.

Title of appropriation.	July 1, 1896, balance unexpended.	June 30, 1897, amount expended and liabilities incurred during fiscal year.	July 1, 1897, balance unexpended and available.
Land to extend aqueduct	$24,454.84		$24,454.84
Extension of aqueduct	150,902.42		150,902.42
Main connections	1,989.18		1,989.18
Land for reservoir	173.09		173.09
Constructing reservoir and gatehouse	78,538.01	$522.05	78,015.96
Water rights and land to extend dam at Great Falls	44,882.04		44,882.04
Aggregate	300,939.58	522.05	300,417.53

APPENDIX B B B.

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS IN THE DISTRICT OF COLUMBIA—WASHINGTON MONUMENT.

REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1897. OFFICERS IN CHARGE, COL. (NOW BRIG. GEN.) JOHN M. WILSON, CORPS OF ENGINEERS, AND COL. THEODORE A. BINGHAM, U. S. A.

OFFICE OF PUBLIC BUILDINGS AND GROUNDS,
Washington, D. C., July 19, 1897.

GENERAL: I have the honor to submit the following report of operations upon public buildings and grounds in the District of Columbia, under the Chief of Engineers, during the fiscal year ending June 30, 1897.

Col. John M. Wilson, Corps of Engineers, United States Army, was the officer in charge from the beginning of the fiscal year until February 8, 1897, when he was promoted brigadier-general and Chief of Engineers.

From February 8, 1897, First Lieut. John S. Sewell, Corps of Engineers, was temporarily in charge, under the direction of the Chief of Engineers, until March 9, 1897, from which date until the end of the fiscal year the office has been in charge of Col. Theodore A. Bingham, United States Army, captain, Corps of Engineers.

In addition to the public buildings and grounds, this office has also been charged with the care and repair of the Government telegraph lines connecting the Capitol with the various Departments and the Government Printing Office; of the repair and improvement of the Government Printing Office; of the repair of the building on Tenth street NW. where Abraham Lincoln died; of the construction of the statue of Gen. John A. Logan; of such matters connected with the erection of the statue of General Sherman as may properly devolve upon the War Department; of the monument at Wakefield, Va., the birthplace of Washington, and the iron-pile dock erected under the supervision of this office in 1894, under the direction of the Department of State, at the mouth of Bridge Creek, Virginia; and of the erection in the National Military Park at Gettysburg, Pa., of the memorial tablet to Abraham Lincoln.

As it would be difficult to improve on the arrangement or wording of the previous annual reports made by my predecessor, copious extracts therefrom have been made where needed, in discussing various subjects.

THE IMPROVEMENT OF THE PUBLIC GROUNDS IN THE DISTRICT OF COLUMBIA.

While all persons justly concede the utility and value to the capital of the nation of the system of parks and public spaces at the intersection of its streets and avenues and the important relation they bear to the health and welfare of the citizens, many of whom, from the requirements of official duties, must reside here nearly continuously during the year, the many indirect yet not less valuable agencies extending from them in promoting mental growth and cultivating a love for horticulture, arboriculture, and floriculture among our people, who congregate here from all sections of our country, do not seem to be fully understood or appreciated.

Prior to the commencement of the improvement of the Smithsonian Grounds in 1851 by that celebrated landscape architect and gardener, Mr. A. J. Downing, it is believed that few extensive park improvements were contemplated or had been made in any American city.

Now many of our largest cities have within their limits extensive and highly improved public parks, the expenditures therefor in some instances approximating to millions of dollars. However large the cost has been, the benefits accruing therefrom have invariably amply repaid the labor and expense.

Increased revenues have been derived from taxation caused by the rapid increase in value of adjacent lands and from the handsome and costly buildings usually erected in the immediate vicinity of the parks.

The effect upon the health and morals of the people benefited by these improvements has been of the most marked and beneficial character.

In the opening paragraph of a recent publication, Washington has been described as follows:

> Washington is in a double sense the capital city. It is the capital of one of the foremost nations of the earth, and it is first in beauty and attractiveness among all of the cities of the American continent. It is in many respects the most interesting city in America, and to it thousands of tourists make pilgrimages from all parts of the world.

If this language is too strong, and Washington is not the most beautiful and attractive city in America, surely as the capital city it should be made so, and the parks and park places so freely distributed through it by the wise foresight of the great man who laid it out, and which are conceded to form one of its chief attractions, should be maintained in the very highest condition of improvement.

This can only be done by liberal appropriations from Congress for their support, as they are the exclusive property of the United States.

The improved reservations of the Government, comprising the public grounds, have been mainly created under the direction of the Chief of Engineers, United States Army, the officers detailed for the duties having been most earnestly, ably, and efficiently assisted by Mr. George H. Brown, the public gardener, whose taste, skill, intelligence, and untiring industry have been freely and promptly devoted to this beautiful work.

Mr. Downing designed extensive improvements, but his death prevented him from executing them. Under his direction Lafayette Park was improved and planted and a portion of the Smithsonian Grounds beautified. He formulated plans and projected minor improvements of other parks which were subsequently partly adopted.

During the period between the death of Mr. Downing in 1852 and the assignment in 1867 of the control of the public grounds to the Chief of Engineers no improvements of any importance were made except those around the Agricultural Department. Since 1867 all of the prominent parks and park places, with the exceptions noted in the foregoing, have been improved under the direction of the Chief of Engineers, United States Army, with the limited appropriations made by Congress for that purpose. How well the task has been accomplished, how carefully the funds have been used, the many compliments paid to Washington on her park system by her sister cities and by distinguished visitors from abroad abundantly testify.

It is also conceded that our parks, by the manner in which the improvements are maintained, evidence more care than is generally exercised in such work except where large expenditures are made. This is encouraging in view of the fact that it is believed that a less amount per acre is expended in their care and maintenance than in any other locality where similar park systems are maintained. This condition of affairs is, in some measure, due to the great care exercised by the Government in making expenditures for the purchase of materials and for payment for superintèndence, labor, etc. It is a notable fact that the Government has been apparently fortunate in securing good materials and very good service in all work connected with the parks. Unfortunately, for the next fiscal year the appropriations for this very important work have been reduced, and while there is every evidence that what has been done is fully appreciated, it is feared that the great work yet to be accomplished is not fully realized. It is earnestly hoped that the Congress soon to convene will evince that interest in our beautiful parks that their importance demands, and that sufficient funds may be allotted to push to speedy completion projected and necessary improvements in a manner commensurate with their importance, not only for the purpose of adorning the capital city, in which all citizens have a just pride, but to furnish an example of simple landscape gardening and park ornamentation that will have a direct influence in aiding to elevate the taste of all visitors, and that may eventually lead to the transformation into beautiful parks of many pieces of waste ground adjacent to the cities of our country.

With these facts before me, I respectfully submit the following report of work done during the year, with suggestions for improvements which are deemed necessary:

PUBLIC BUILDINGS.

EXECUTIVE MANSION, GREENHOUSES, AND STABLE.

In addition to the usual care extended to the Mansion and its furniture, the following has been accomplished during the year:

Painting, exterior.—All the roof balustrades, the crown molding of cornice, window heads, sash, and water table, all the white work on the roof, including the flagstaff, which was repaired after being broken in the storm of September 29, 1896; also all the dark stonework on the north, east, and west fronts, all window sills, window and door frames under north portico, 15 columns, the top of east portico, base of the building below the water table, the flagstaff stairs and platform, and 66 roof platforms laid to prevent wear on the tin roof.

Painting, interior.—The woodwork was painted as follows: Eight rooms on second floor, including bath and dressing rooms; the two dining rooms, including pantry, main corridor, blue and green parlors, and east room on the first floor; also sundry passages, doors, articles of furniture, window frames, and sash. Mantels were cleaned and fireplaces painted where necessary. All grained work throughout the entire house was sandpapered, done over, and varnished. All hard-wood doors were varnished; all gold work touched up where necessary. Fifty-four hatboxes were repainted and numbered in paint. Much miscellaneous painting and varnishing was also done, such as table legs, edging of sinks, kitchen and laundry furniture, various closets, boxes, screen doors, ladders, and storm sash.

One hundred and sixty-two lights of glass were renewed and edges of sash painted.

Chandeliers and gas fixtures were covered during the heated term and thoroughly and minutely cleaned, repaired, and kept in good order throughout the year.

Canopies were erected and floor covers spread for the official receptions in January and February and removed when no longer needed.

Much work in miscellaneous plumbing was done, such as repairing and replacing water fixtures, cleaning strainers and traps, renewing washers, repairing breaks, sewer connections, and water-closets, repairing fountains, placing temporary drinking fountains in the grounds, etc.

The large cistern at the east end of the house was pumped out and cleaned.

The entire system of plumbing and sewerage of the Executive Mansion was tested by hydraulic pressure, a much more severe one than the odor test. It was found to be in fair condition, but not such as ought to exist in the home of the President of the United States. As thorough an actual examination of sewer connections was made as could be done without *complete* excavation of all pipes. Old records were looked up and new drawings were made of the entire system of pipes in and under the Executive Mansion and greenhouses, and a detailed and valuable report was made by a professional expert in these matters.

The present plumbing in the Mansion is a growth of additions and patches. There is no system, properly speaking. It is not in a dangerous condition, but it is expensive to keep it from becoming so. The whole should be overhauled and relaid, useless parts cut out, proper sewer connections made, old sewers excavated and their beds cleaned, etc. This will cost not less than $5,000.

The spring at Franklin Square supplying the Executive Mansion was cleared of 6 inches of mud, which was replaced by clean gravel. This spring has of late years been getting lower. It ceases to flow at the Mansion in the warm season and does not begin again until late in the winter season. The supply pipe was cleaned out by using the pressure from the Potomac mains.

All doors and windows were eased, and new sash chains put in where required. The chimneys were swept and the exterior of the Mansion washed, using a steam fire engine for that purpose.

The plastering in the basement corridor has been repaired and a portion of the corridor whitewashed.

The library has been papered, new matting laid on floor, and the furniture covered with new materials.

Tiling in large and small kitchens and in the entrance vestibule was repaired.

All lace curtains have been laundered and repaired, new lace curtains placed in the east room, forty dining-room chairs repaired and regimped, new oilcloth placed on all the tables in butler's pantry, and the silver drawers in private dining room partitioned and lined. Tables were scraped and refinished, and two large chairs and one screen regilded. Leather furniture in upper corridor was regimped and repaired. Old defaced moldings in southwest bedroom were replaced with new materials.

New matting has been laid on the floors of the east room, blue, green, and red parlors, dining room, state dining room; the main corridor, first floor; main corridor, second floor; anteroom, first floor; stairways, landings, and elevator hall. The matting in the various bedrooms was cleaned. The green doors leading from butler's pantry to dining room have been repaired and re-covered. The portraits of the Presidents in the Cabinet room have been cleaned and varnished, and the frames of the large mirror and of one portrait in the library have been regilded.

All furniture throughout the Mansion requiring it was repaired, cleaned, and varnished or refinished, and all brass curtain poles and rings were cleaned and reburnished.

The ceiling of the President's office was repaired and redecorated; the walls of the telegraph room scraped and repapered. New carpets were purchased for the east room and for the green parlor.

The Mansion escaped serious damage by the hurricane of September 29, although the flagstaff on the roof was struck by a piece of timber from the board walk and broken off near its base; it was promptly repaired and replaced in position. Twenty-nine panes of glass were broken and at once reglazed. The sheet-iron caps were blown from the chimneys on the east side and were promptly replaced. The high iron fence at the north front, the stone coping and the piers at Pennsylvania avenue entrances were damaged by falling trees; they were repaired as soon as possible.

In October, 1896, all carpets were relaid, all lace curtains and window draperies hung, and the mansion placed in order for the winter. In June, 1897, all the carpets were taken up, cleaned, and stored in the state dining room, and the window draperies taken down, cleaned, folded, and stored away in the attic for the summer, and the lace curtains removed from the windows and sent to the laundry. Thirty-nine new window shades have been purchased and hung, and a new five-fold screen, covered with silk, purchased.

Nine chairs were repaired, reupholstered, and re-covered with new material.

The elevator has been overhauled and put in complete order, and an electric machine for operating it has been purchased and will be placed in position during the coming year.

The exit bridge at the north front, and the storm doors at that front and at the red-room window, and the canopies, were placed in position for all receptions during January and February, in addition to the hat and cloak boxes for evening receptions. The east room and parlors were elaborately decorated with plants and flowers on these occasions. Canopies were erected and floor covers spread for these receptions and removed when no longer needed.

New carpets were laid in the main corridor, the west-end corridor, and the elevator hall, first floor, and in the elevator car.

The walls of the northwest bedroom were repapered and the ceiling frescoed; the walls and ceiling of the northwest dressing room adjoining were repapered and the cornice tinted. The woodwork in both rooms was repainted, both apartments recarpeted and furnished with new brass window grills and lace and silk drapery curtains, and the furniture in both rooms reupholstered and re-covered with new materials.

The walls and ceiling of the large bathroom on the north front, second floor, were decorated in color, surrounded with border, the centerpiece gilded, and the woodwork painted with two coats of oil color.

Some additional furniture has been purchased. New covers of wood have been placed upon the stone steps leading to the area of the Mansion at the northeast corner.

The floors of the east and west ends of the corridor on first floor were strengthened by placing additional supports between the floor joists and the ceiling joists of the basement. One of the brick arches of the first floor was found to have been cut out. It was repaired and portable supports of timber were made for use under those floors and the floors of state dining room and east room for strengthening them when subjected to the increased weight imposed by the large crowds attending receptions. Repairs were made to hinges and locks, some new door sills were put down, repairs made to the floors in three rooms, and other minor carpentry done as required.

Extensive improvements have been made in the small reception room adjoining the entrance vestibule. The old fireplace has been torn out, reconstructed, and retrimmed, an oak mantel placed in position, and the hearth tiled; a new floor has been laid, the room wainscoted in oak, the ceiling decorated, the side walls covered with woolen textile material, and the doors and windows refinished.

Three sets of slip covers were made and placed upon furniture, and the five large awning frames used on the south portico re-covered with new canvas.

The walls of the northeast bedroom have been scraped and pointed and the room repapered and repainted, and the furniture in two of the bed chambers and in one dressing room is now being reupholstered and re-covered with new material.

Extensive repairs were made to the tin-roof covering. All the old tin was removed from the gutters and for a distance of about 8 feet up the slope of the roof (with the exception of that portion over the north portico which was found in good condition), and replaced with new tin and the entire roof repainted. A portion of the old sheathing, where found to be rotted, was replaced with new boards. Thirty-seven hundred square feet of new tin was placed on the roof. Minor repairs were also made to other portions of the roof where required. A plank walk in sixty-six sections was made, painted, and placed in position along the roof gutter where there is most travel, due to inspection and repair of telegraph and telephone wires. New steps were erected leading from the gutter to the platform of the flagstaff. Twenty-two wire guards were purchased and placed over the rain-water spouts, and a portable derrick for use in hoisting materials was made and placed upon the roof.

Attention is again invited to the importance of providing suitable offices outside of the Executive Mansion for the President of the United States. This matter was discussed in annual reports for 1893, 1894, 1895, and 1896.

It is earnestly hoped that this important matter may no longer be delayed, and that action may be taken at the approaching session of Congress toward erecting a suitable office building for the President of the United States.

The repairing and painting of the greenhouses was commenced on July 6 and finished on September 4, 1896.

The furnaces, flues, chimneys, and pipes received a general cleaning out, new grates were put in two furnaces, some burnt-out stovepipes were replaced by new ones, the brick chimneys were pointed up, additional heating pipes for a small propagating bed were put in in the west end of the rose house.

A new tin roof was put on one of the furnace rooms and the tin roof blown from the grapery was replaced by a new one. A small brick wall was put up for a solid bed in one of the greenhouses and a small propagating bed was bricked in on three sides.

All the rotten woodwork in the different greenhouses was renewed or repaired, all new woodwork was painted two coats, and about 1,000 lights of broken glass were replaced.

New sanitary water-closets have been introduced under the conservatory in place of the old-fashioned closets which were badly out of order, and some slight repairs made to the woodwork of the building.

Proposals were opened and a contract entered into during the month of June for furnishing the ironwork and the woodwork required for repairing the west wing of the conservatory.

The hurricane of September 29, 1896, blew off the small solid roof of the grapery and landed it on a cold bed, smashing six sashes with the glass; it blew down the top of a brick chimney, breaking in the roof of a furnace room, and blew off one large sash from the conservatory, breaking the frame and all the glass; some broken limbs from the trees were blown on the greenhouses, breaking in all about 400 lights of glass and a couple of small rafters on one of the greenhouses.

The damage done by the storm to the greenhouses was at once repaired.

There were purchased during the year, under contract, 17,968 flowering bulbs for the greenhouses and for the ornamentation of the grounds.

The general collection of plants in the greenhouses and the conservatory received their annual potting and tubbing. The following bulbs and roots were planted either in boxes or pots for forcing during the winter months in the greenhouses: 2,240 hyacinths, 450 liliums, 6,000 convallarias, 118 spireas, 1,460 narcissus, 4,175 tulips, 600 freesias, and 100 callas; 15,143 bulbs and roots in all. About 1,300 roses, 2,300 carnations, and 1,000 chrysanthemums were grown on solid benches or in pots for cut flowers.

For the ornamentation and decoration of the greenhouses, conservatory, and the Executive Mansion nearly 6,000 plants of all descriptions were grown; 1,500 young roses, 2,500 carnations, and 800 chrysanthemums were also grown to replace old stock; about 1,100 amaryllis and other bulbous plants were grown besides the general collection.

Attention is again invited to the conservatory, the frame of which is of wood, rapidly decaying and almost in a dangerous condition. A new iron superstructure, at an estimated cost of $15,000, is necessary.

Repairs are made from time to time to the old superstructure, but it seems almost a waste of funds to patch up portions of an old decayed wooden frame with wood, which will also decay, when a violent storm might possibly wreck the structure at any time.

At the President's stable the roof of carriage house, skylights, cellar windows, parts of the outside woodwork, and 34 sections of iron fence were painted. Ninety-six lights of glass were renewed or reset. Water and gas fixtures were kept clear and repaired where necessary. Traps and drains were cleaned. Necessary repairs were made to stalls, sinks, etc., and new gratings were placed over drains where required. Brickwork was repaired and pointed, new covers for 10 cellar windows made and placed in position, the roof of the carriage shed and its skylight windows were repaired, new hinges placed on shutters of building, and new cupboards and saddle racks made.

In the yard of the stable 31½ square yards of asphalt pavement was resurfaced.

In the stable of public buildings and grounds some carpentry repairs were made and the wagon house extended 24 by 22 feet.

The White House stable should be removed from the grounds fronting the State Department and the beautiful new Corcoran Art Gallery, where it is an eyesore and manifestly out of place, and where it now seriously interferes with the development of that part of the nation's parks.

WASHINGTON NATIONAL MONUMENT.

Every effort has been made to maintain the Monument and its machinery in good condition.

Vandals continue to give annoyance by occasionally chipping pieces from the outside or from memorial stones in the inner walls. Whenever detected, these thoughtless persons are arrested, but, as a rule, when brought to trial, escape with a small fine.

The elevator and all machinery connected therewith has been critically inspected monthly by an expert from the Otis Elevator Company and pronounced in excellent condition. Weekly inspections are made by the principal steam engineer and machinist at the Monument, and daily tests of the safety appliances of the elevator are made by the employees before starting to convey passengers to the top. It is believed that the elevator is as safe as it is possible for man to make it, and every effort is made to prevent accidents. Should an accident ever occur, it will result from something which it was impossible to foresee.

During the inaugural week of 1897 the Monument was decorated by four flags hung one each side from the windows at the top. This work required the Monument to be entirely closed two days, and on other days the necessary framing for the flag poles so blocked up the top room as to lessen the number of visitors accommodated. Probably the visiting strangers who were deprived of the opportunity to ascend the Monument were a thousand or two in number.

Elevator cables were oiled twice and worn parts were renewed.

During the hurricane of September 29, 1896, the storm and lattice doors at the entrance to the Monument were blown out and broken and had to be repaired.

The same storm blew the copper roof off the engine room and broke eleven panes of glass. These were renewed.

At the boiler house the storm blew off the ridge pole and broke slate and glass, which were renewed.

The boilers were cleaned out inside, examined and tested, and found to be in good condition and perfectly safe for any pressure such as is now demanded. Furnace walls were repaired and a new arch plate put in. The boilers are tight and steam well.

Eight new tubes were put in the feed-water heater and a bye-pipe device made. The heater now works well and can be repaired without stopping all the machinery. This heater saves from 3 to 5 per cent of coal consumption.

A new steam trap was placed in the tunnel reaching from boiler to engine room. Expansion has caused trouble in keeping this in good order.

During the first half of the year asbestos was used to pack the joints of the long steam-supply pipe, but condensation caused it to run and the joints to leak. The gaskets are now cut from Jenkins's packing and last well, keeping joints tight.

The boiler house has been thoroughly cleaned up and whitewashed inside, and 18 feet of 4 inch drain pipe laid to drain the down spouts.

Dynamo, engine, and wiring used for lighting the Monument are all in good condition One armature has been repaired and not used since, hence is good as new. This plant is in good condition and gives no trouble.

The roof of the lodge house has been repaired, and interior ceiling walls and woodwork calcimined, painted, and varnished. The structure is now in very good condition, except that it still absorbs moisture owing to the poor condition of the mortar used in construction. The water-closets have been put in good order. The heating boiler has been cleaned and painted.

The entire plant is now in some respects in better condition than it ever was.

The old papers, pictures, and property connected with the erection of the Monument from its earliest period have been collected, cleaned, assorted, and stored together where they are easily available.

All unserviceable tools and material have been removed and condemned, and all rooms and closets connected with the Monument have been overhauled and cleaned up.

The ironwork in the interior of the Monument from the 130 foot landing down to the 40-foot landing has been given one coat of white zinc paint, the hand rail from the 40-foot landing down to the bottom floor was repainted, and the white work around the cage of the elevator car and the outside of door and frame at the entrance to the Monument given one coat of white paint. All of the ironwork in the Monument has now been painted, most of it with two coats.

The copper on roof of the engine house was given two coats of paint and the hand rail around the same house one coat. The joints of the stonework of the south face and part of the west face of the lodge house have been repointed.

During the twelve months ending June 30, 1897, there were 165,595 visitors to the top of the Monument, of which number 105,082 made the ascent by elevator, and 60,513 by the stairway. This makes a total of 1,409,822 who have visited the top of the Monument since it was thrown open to the public October 9, 1888. It is a noteworthy fact that no one has yet been killed or fatally injured either during the erection of the Monument or its administration since completion.

BUILDINGS OCCUPIED AS OFFICES BY THE WAR DEPARTMENT, EXCEPT STATE, WAR, AND NAVY BUILDING.

Under date of June 30, 1893, this office was charged with the preservation, care, and safety of the following buildings:

Army Medical Museum.

Ford's Theater Building.

Annex to Ford's Theater Building.

No. 610 Seventeenth street, occupied as offices by Record and Pension Bureau.

No. 1725 F street, occupied by War Department printing office.

No. 1744 G street, occupied by Rebellion Record Office.

No. 1814 G street, occupied by Medical Department, United States Army.

Annex to Winder Building, occupied for storage purposes by Ordnance Department, United States Army.

War Department stables.

All of these buildings have been inspected at least once each month during the fiscal year, and are believed by me to be in a perfectly safe condition for the purposes for which they are occupied.

The ordinary minor repairs required from time to time are made under the direction of the chief of the supply division of the War Department, and paid from the regular appropriation for contingent expenses of the War Department and its bureaus.

WAR DEPARTMENT BRANCH PRINTING OFFICE, NO. 1725 F STREET NORTHWEST.

The sundry civil appropriation act, approved June 11, 1896, provided the sum of $5,649.25 for the repair of this building.

Under this act the following work has been done:

The old annex has been torn down and a new brick annex constructed. The old main building has been repainted inside and out, new floors laid, a new steam heating apparatus introduced, windows overhauled and repaired, all sash rehung with steel sash chains, six windows fitted with new sash, minor repairs made to a number of the frames, and the frames and sash painted with two coats of paint. The stairways have been overhauled and repaired and nine new steps put in. One flue in west wall has been straightened and adapted to the use of the new heating plant. An opening was cut to light the basement stairs, the old door at the main entrance renewed and a new door and frame placed in position. New water-closets have been placed in the basement. The old ceilings were removed and metal ceilings put up, the papering of one room repaired, and the walls of one room calcimined. Improvements were made to the plumbing and water pipes. The tin roof covering, which was destroyed during the gale of September 29, was replaced with a new one; 34 new gas jets have been placed in position.

REPAIRS AND ENLARGEMENT OF GOVERNMENT PRINTING OFFICE.

Eleven steel doors were placed in position during the month of July, 1896, for the purpose of closing when necessary, the door openings cut between the old H street wing and the new west wing of the building.

Four hundred and thirty-two cast-iron hangers for the electric cables in the new west wing were purchased and delivered to the Public Printer in August and September, 1896, and an electric annunciator was purchased and placed in the elevator in that wing in August, completing the operations upon the new building so far as this office was concerned.

No other repairs will be made by this office upon the H street wing until the Public Printer thinks they can be undertaken without interfering with the important work of his office.

On June 10 there was referred to this office by the Chief of Engineers, with directions that the arches be examined at once and such work done as might be necessary, a letter from the Public Printer stating that some of the arches in the addition to the Printing Office were loose, permitting sand to sift down upon the work. An inspection of the arches was at once made, when it was found that none of the arches were loose, but that the trouble was caused by the dropping of such loose dust and fine sand as might have been left in the corners of the ceiling during construction down through holes in the tiles at the ends of small crossbeams, where they had been chipped to fit into position.

In order to prevent any possibility of further dust sifting down from the vibrations of the building, caused by heavy machinery, the holes in the tiles have been filled up with Portland cement and the repaired places calcimined.

FORD'S THEATER BUILDING.

Work for providing a room in this building for the electric storage battery was done under the supervision of this office. It consisted in cutting certain openings for ventilating purposes, constructing a brick retaining wall and laying a brick pavement in the basement.

HOUSE ON TENTH STREET BETWEEN E AND F STREETS NORTHWEST, WHERE ABRAHAM LINCOLN DIED.

The act of Congress approved June 11, 1896 (sundry civil appropriation act), provided $30,000 for the purchase of this house by the United States and the further sum of $1,000 for its repair after purchase. The duty of making the purchase was assigned to this office by letter of June 24, 1896, from the Chief of Engineers.

Correspondence was at once commenced with the owner of the building, and under date of June 29 she stated, through her agent, that she was prepared to sell for the amount appropriated.

The purchase of the building was consummated during the early part of the month of November, at a cost of $30,000, the title having been declared perfect by the United States district attorney, and the United States assumed charge of the premises on November 10, 1896.

A careful examination was at once made of the building and it was found to be sadly out of repair. A report, together with an estimate of the cost of putting it in good condition, was submitted by this office to the Chief of Engineers, and on November 27 the officer in charge was instructed to put the roof in good order and to repair the damage done to the chimneys by the gale of September 29, 1896. Proposals were at once invited, to be opened December 7, and during that month the necessary repairs were made. This included rebuilding two brick chimneys and part of a fire wall and pointing up joints, new copper flashing for the roof, and repairs to slate work.

In April, 1897, minor repairs were made to a leaking water-closet and the joints of a stone post under the front door were repointed.

The sum of $827 is still available for repairs, but in accordance with instructions from the War Department no additional work of repair will be undertaken until it is learned whether Congress will take any further action in connection with the building.

The house is now (June, 1897) in charge of a Mr. Oldroyd, who is occupying it free of rent and acting as temporary custodian without pay.

It is estimated that to put the building in good condition will require the sum of $4,000.

IMPROVEMENT OF THE PUBLIC GROUNDS IN THE DISTRICT OF COLUMBIA.

VARIOUS RESERVATIONS.

The area covered by the parks and park spaces in the District of Columbia under charge of this office is about 405 acres, within which there are 13.4 miles of gravel and asphalt walks, covering an area of 16.9 acres, and 7.6 miles of gravel and asphalt roads, covering an area of 33.03 acres.

There are in all 301 reservations, varying in size from a few hundred square feet to 82 acres. These reservations are classified as follows:

	Number.	Acres.
Highly improved	94	351.12
Partially improved	39	5.27
Unimproved	168	48.69
Total	301	405.08

Of these, 66 are inclosed with post-and-chain and other low iron fences.

The annual report of my predecessor for 1893 outlines a general plan for the development of park improvement.

Each year an effort is made to add to the list of improved reservations, but owing to lack of necessary funds the progress is very slow. It is not generally realized how much beauty the smaller spaces are capable of exhibiting should they be brought to their highest condition of improvement. It is in a measure true that the outlay in this development is considerable, but the subsequent maintenance of these spots of beauty in their highly improved condition is comparatively light and not much more than the expense now incurred in mowing their grass surface.

With this report partial estimates are submitted for the partial improvement of the following:

1. *Reservation No. 19 (immediately north of navy-yard).*—At the request of a committee of citizens of the District of Columbia a plan of improvement of this reservation, at an estimated cost of $12,000, has been prepared. The reservation covers an area of about 3½ acres. It is located in a section of the city which has not yet been highly improved, and is bounded on the north by the tracks ot the Baltimore and Potomac Railroad Company. A side track extends through it to the navy-yard. The adjoining streets are unpaved, no sidewalks have been laid, and the streets bounding the reservation are not curbed on the reservation side. In the western section a narrow stream meanders through a small ravine and finds its outlet in an improvised opening in a street sewer. It will require about 3,000 cubic yards of earth to fill this ravine and bring the reservation to proper grade.

It is proposed to lay sidewalks on the east, west, and south boundaries; to construct gravel walks, lay out lawn plots and sow with grass seed; to introduce water, construct necessary drains, drain traps, and gutters; to plant with suitable trees, shrubs, and flowers, and to place eight park lamps in position. Five thousand dollars is requested to commence the work.

2. *Reservation No. 20, Howard University Park.*—This reservation covers an area of nearly 12 acres; is located south of the Howard University, between Fourth and Sixth streets. Its improvement has been urged from time to time by prominent citizens, and a plan for its ornamentation was submitted in 1894, at an estimated cost of $25,000.

The reservation is covered with a native forest growth of large oak trees. The major portion of the ground is a little below grade of the surrounding streets, but is not wet except at the southeast corner of the park, where apparently there are springs. The ground generally slopes toward the south and east and admits of easy surface drainage.

The reservation is admirably located for a public park, for pleasure grounds, games, picnics, etc., and for other assemblages of our people, being within a few squares of the terminal sections of four of our city and suburban street railroad lines, by which any part of Washington and its chief outlying suburban villages can be reached from the park in a comparatively short period of time.

It is believed that if the improvements projected were made, this park would soon become a popular place of resort and relieve the city parks proper, which should receive a higher grade of improvement.

With this object in view it is designed to preserve as fully as may be practicable the present native forest growth of oaks, which furnish an abundant shade, and to form additional plantings of other varieties of ornamental trees and shrubs bounding the parks on all sides, so that there may be many shaded walks and drives in the summer and autumn opening out into sunny glades in the more central portions of the grounds. It is proposed to construct gravel walks and roads only; to make but few changes in the present surface grades, terracing the northwest section, where the greatest difference of level exists between the street and park grades; to introduce water for drinking fountains, closets, irrigation, and to construct such drains to street sewers as are necessary to properly drain the lower portions of the grounds, and to request the District government, which claims control of all streets from building line to building line, to construct sidewalks around the reservation. The park will be lighted by electric lamps. Five thousand dollars is suggested with which to commence the work.

Reservation No. 140.—This reservation is located at the intersection of New Hampshire avenue and M street NW., and frequent requests have been made for its improvement by residents of the vicinity.

It is in a section of the city which has been greatly improved in recent years and generally occupied by private residences.

The sidewalks about this reservation are to be constructed at once by the city government. Hence the time is very suitable for improving this reservation.

The reservation covers an area of about 7,000 square feet. It is proposed to grade it, lay out lawns and flower beds, plant shrubbery, and construct asphalt walks, at a total cost of $2,000.

There are still 168 of these little spaces unimproved throughout the city, and if the general appropriation for various reservations could be increased to $20,000 annually they could be gradually transformed into exquisite little parklets and add greatly to the beauty of our capital city.

CHILDREN'S PLAYGROUNDS.

By the act of Congress approved August 30, 1890, the officer in charge of public grounds was authorized to set aside a portion of the public grounds for a children's playground, under regulations to be prescribed by him. The southern portion of the Monument park was at once set aside for this purpose, but no regulations were prescribed, as there were no means of carrying them out, no watchmen or policemen having been authorized, and the service of the one watchman on duty at the Monument being needed there to protect the structure from acts of vandalism.

Just complaints were received that the lawns were being destroyed, trees injured, and that the children's playground was overrun by vicious and improper persons. This office has been requested to take action to relieve the grounds of such characters, and has been obliged to call on the District police for assistance.

To protect the improved grounds as far as possible, and to prevent serious annoyance to those enjoying the beauty of the park, the playground was transferred in the autumn of 1893 to the site between B street and the main drive north of the Monument. This plot of ground covers an area of about 8 acres and is occupied nearly all the time by men and boys playing football or baseball.

By the act of Congress approved March 2, 1895, the officer in charge of public buildings and grounds was directed to authorize the use of a portion of the grounds within the ellipse south of the Executive Mansion for a children's playground, under regulations to be prescribed by him.

Notice was given through the public press that children applying would be authorized to play lawn tennis, croquet, cricket, and kindred games. The only requirements were that the children should be recommended by any reputable citizen, and would agree to exercise the common rules of courtesy which would govern them in a private park.

But two requests were received for this privilege. Both were promptly granted, but in neither instance was advantage taken of the permit.

Several applications from young men to play football and baseball in the reservations were received, but it was not believed that it was intended under the law that the lawns of the ellipse or other parks should be used for these purposes.

It was anticipated that during the fiscal year 1896–97, the reservation at the intersection of Georgia and Virginia avenues, which covers an area of about 2 acres, and which was turned over in the summer of 1895 for use as a playground for children, would be fenced in, water introduced, and trees planted. Unfortunately, no funds have been provided for this purpose.

These playgrounds should be set aside in various parts of the city for the use of children, not to be monopolized by grown persons or half-grown youths, nor to be used for games prohibited under the police regulations of the District.

Howard University Park, either highly improved or in its present condition, could well be selected for this purpose, and many of the smaller reservations throughout the city, which have not been highly improved, could be set aside for playing lawn tennis, croquet, and kindred games.

If Congress approves the suggestion and deems it best to continue the privilege extended by the acts of August 30, 1890, and March 2, 1895, there should be some punishment prescribed for breaches of the rules and regulations governing the parks; and there should be regular watchmen on duty at all hours, not simply for eight hours of the day. The duty of these watchmen should be to prevent improper characters from interfering with the children and to see that all proper regulations are thoroughly enforced.

GROUNDS OF EXECUTIVE MANSION.

These grounds were kept in good order during the year. During the summer months the flower beds were kept well trimmed and staked, the lawns mown about once every week, the roads and gutters edged and weeded, and the water plants in the fountains cared for.

All the flower beds were cleared of the plants after the frost had injured them. They were manured and spaded up, and 45 of them planted in October and November with 34,350 tulips, 9,980 hyacinths, 17,275 crocus, 600 scillas, 1,000 narcissus, or 63,205 bulbs in all.

Five thousand plants of pansies, myosotis, and daisies were among the bulbs or in separate beds.

For the purpose of planting the flower beds and borders this spring, the following plants were propagated during the fall, winter, and spring months: 1,400 cannas, 3,600 geraniums, 2,000 achyranthes, 3,500 coleus, 9,000 althernantheras, 5,500 miscellaneous bedding plants, 14,000 echeverias, 1,000 begonias, 4,500 seedling plants, and about 1,800 gladiolus and tuberose bulbs.

In May and June the bulbs were removed from the beds and stored for next season's use, and the beds replanted with summer bedding plants. About 38,000 plants of all descriptions have been planted in the 70 beds and borders in the grounds. Tropical and hardy water lilies were set out in the basins of the three fountains, and some of the large palms and camellias were removed to the grounds for the summer.

In June the elm trees in these grounds were sprayed with a decoction of London purple and water to stop the ravages of the elm beetle.

Five hundred and seventy-two sections of iron fence, 36 sections of wire fence, and 20 gates were painted. Ten lamps and lamp-posts in various parts of the grounds were painted and bronzed as needed.

The gravel was removed from the surface of the roadway at each end of the piece of asphalt pavement at the entrance to the south portico of the Executive Mansion, and 283.07 square yards of additional asphalt roadway pavement laid. The gravel removed was used in repairing the gravel roadways in these grounds. Necessary repairs were also made to the asphalt roadways in the grounds north of the Mansion, an area of 297.78 square yards being resurfaced.

Great damage was done to the trees, shrubs, and plants by the hurricane of September 29, 1896, which must have been one of the worst in the history of Washington. The canna and standard lantana beds were blown to the ground and ruined for the season; 50 of the finest and oldest trees were blown down and uprooted; another 50 were so badly disfigured that they had to be topped off and cut back. About 75 others were more or less badly injured—only the broken limbs and stumps were cut out of these.

Some of the trees on the grounds north of the Executive Mansion were thrown across the iron fence and sidewalks. The fence was smashed in several places, breaking the stone coping and one gatepost. The fence and post were at once repaired and broken stone coping replaced by new.

The grounds were cleared of all trees, stumps, and litter in seventeen days, nearly 500 cart and wagon loads of wood and brush being carted away. A number of badly disfigured trees were taken up or cut back during the winter months. About ten more were left, which could not be taken up for want of time and money to employ extra help. Seventy new trees and shrubs in 35 varieties were planted in place of those destroyed, 60 cart loads of good soil were carted to the holes, and the same amount of clay and gravel carted away.

The old tree holes were filled up, leveled, and sodded or sown in grass seed.

PROPAGATING GARDENS, INCLUDING THE GREENHOUSES AND NURSERY.

Extensive repairs were made to the various greenhouses and potting houses during the year, and the large and valuable collection of plants was maintained in good condition.

A new house for growing carnations, the ground for which was graded and the plant benches constructed just prior to July 1, 1896, was built during the early part of the fiscal year. The house which has been numbered 19 is 110 feet long, 18 feet wide, and 12 feet high. The house has a flagstone walk, and is heated by a hot-water boiler (placed in a brick-lined stokehole 18 feet by 12 by 7 feet, constructed at one end of the house), and 1,000 feet of 4-inch hot-water pipe. A potting shed addition to this new house, 18 feet long, 12 feet wide, and 12 feet high, was built over the stokehole containing the boiler.

The superstructure of an old greenhouse, 120 feet long, 12 feet wide, and 9 feet high, which was partially decayed and no longer serviceable, was removed and replaced with a new superstructure, all of the old glass being used in the new work.

Extensive repairs were made to the old rose house, consisting of a partial reconstruction of the roof, the removal of the interior wooden supporting posts and replacing them with iron posts, and reconstructing interior staging.

Extensive repairs were also made to the palm house (the roof structure of which was partly carried from its foundation by the hurricane of September 29), mainly as follows: The roof structure was replaced on the supporting walls and the wall plates and upright framework securely anchored to the brick walls; the damaged roof structure, upright sash, etc., repaired, and the same reglazed and repainted.

Four thousand one hundred and eighty-two square feet of new staging was constructed in the various greenhouses in place of decayed and worn-out staging removed and minor repairs were made to other staging where required, 1,920 feet B. M. of new material being used for this purpose.

The glass was removed from house No. 13, the framework given two coats of white lead and oil, and the house reglazed; a coat of white lead and oil was given to framework on the outside of houses Nos. 11, 12, and 16; the entire framework of house No. 18 was given a coat of white lead and oil; the roofs on the east side of houses Nos. 7 and 14 were reglazed, and the brick chimney of house No. 7 raised 4 feet. The wall plates of houses Nos. 7, 14, and 17 were pointed with cement mortar.

Two hot-water boilers were removed and replaced with new ones; 565 feet of 2-inch hot-water pipe were put up to increase the heating surface; the packing from leaky joints in hot-water pipes was removed and the joints recalked with red lead packing. The brick fronts of four furnaces in two houses were repaired and the flues of all the boilers were opened and cleaned.

A platform and steps were constructed to the office building; the floors of potting sheds, coal bins in storage cellars, and cold (plant) frames adjoining storage building were repaired. Minor carpentry repairs were made to the blacksmith shop, and a wagon shed 20 feet long, 18 feet wide, and 14 feet high constructed adjoining the same. The partially decayed sills of the large storehouse were removed and replaced with new sills and the wooden block supports of the house replaced with brick piers.

The roofs of the blacksmith shop, the adjoining store sheds, and a small frame potting house were covered with tin and given a coat of elastic asphaltum paint; 130 feet of 4-inch tin gutter and 16 feet of 4-inch down spout were made and placed on the greenhouses. The tin used was old material received from the Government Printing Office. A coat of yellow insecticide wash was given to the large frame storehouse and office building and 4 potting houses, and 2 coats of green paint to 16 plant tubs.

The property yard was cleaned and about 20,000 feet of old lumber received from the Congressional Library building was stored. The unserviceable property was collected and assorted, inspected, condemned, and destroyed.

Fifty feet of 6-inch terra-cotta sewer pipe was laid, valves, bibbs, and other fixtures repaired or renewed, and pipe connections made or changed as needed.

All the heating apparatus was looked after and kept in good order, being repaired or renewed as necessity required.

Overflows, supply pipes, and valves of the fish tank and basins for aquatic plants were kept in good order.

The severe windstorm of the night of September 29 blew off a portion of the tin roof from the brick potting houses, broke 11 ventilating sashes, and about 1,000 lights of glass in the greenhouses, and moved the superstructure of the large palm house out of perpendicular. The damage

storm was promptly repaired. The damage to plants was
s caused by broken glass.
the work performed by him on the greenhouse struc-
made 24 new flower boxes and repaired 10 old ones,
boxes and repaired 80 old ones, repaired 274 park
stakes for fastening down settees in the parks,
ng flower beds and 500 small stakes for laying
ed 3 tool boxes, made 4 leaf crates for carts,
in park lodges, and 5 water tanks for the
ridge 35 feet long for use in trimming

own in the greenhouses and frames for
cing: Two hundred and forty-five alysum,
us, 600 bouvardia, 7,336 carnations, 2,000 chrys-
aniums, 881 poinsettia, 360 pansy, 1,658 roses, 3,229
via, 1,244 violets, 360 primulas; in all, 20,875.
potted and boxed for winter forcing, the following bulbs:
usand Roman hyacinths, 2,000 Dutch hyacinths, 4,500 tulips,
narcissus, 2,450 freesia, 500 liliums; in all, 20,450.

There were purchased during the year under contract 66,500 flowering bulbs for planting in the public parks and for stock for the nursery.

There were hauled to the parks for fall planting 5,647 chrysanthemum plants, and for early spring flowering 51,500 Dutch bulbs.

In the fall the stock plants and cuttings were removed from the parks and stored in the greenhouses and frames; 489,475 plants were propagated from them for spring planting on the public grounds.

In May 3,061 plants and 2,800 bulbs were planted for stock and summer bloom, and about 50,000 Dutch bulbs which had been removed from the park flower beds were heeled in to properly ripen.

In June 531 plants were set out in the nursery for stock and summer bloom; 4,551 carnation plants and 2,054 rose plants were planted in the houses for winter forcing; 27,014 surplus bedding plants were furnished for the grounds of public institutions in the District, and the remaining odds and ends of surplus bedding plants left over from the spring planting of the parks were given to whoever applied for them.

In the nursery the lawn surfaces were mown as often as required; the roadways, walks, and gutters were kept clean and free from weed growth. The basket and web caterpillars were removed from the young trees and shrubs, the young stock properly cared for, and the nursery thoroughly scuffled and cleaned.

There were planted in the nursery for stock 2,300 tuberose bulbs, 2,422 young shrubs, and 5,476 plants, and 40 young trees were transplanted (all home-grown stock); 227 young trees, 300 young shrubs, and 231 plants were purchased and planted for stock. The following were lifted from the nursery and planted in the parks: Two hundred and one young trees, 1,275 young shrubs, and 275 hardy vines. There were 4 young trees and 200 young shrubs (home grown) lifted from the nursey and furnished to the grounds of the Congressional Library building.

One hundred and eighty park settees that had been repaired and painted during the winter were hauled to the parks. One hundred and eighty cubic yards potting sod, 95 cubic yards cow manure, and 37 cubic yards sand were received and stored, and potting compost for growing plants was prepared.

One hundred and thirty by three feet of flagstone walk was laid, and 240 feet of ash bed made for growing pot plants on during the spring and summer months. In the fall a trench 446 by 2 feet, outside the fence on the east front of the nursery grounds, was cleaned to carry off the surface water from heavy rains. The vacant grounds were manured and rough spaded. During the winter snow was removed four times from the walks, pits, and cold frames.

The following old material was received from the new building for the Library of Congress: Twenty-six wagon loads of boards, 8 wagon loads of scantling, 1 small wagon load of sash, and 1 workmen's call bell, at the storage grounds in the nursery; 1 mixed load of boards and scantling at Judiciary Park, and 1 at Reservation 17 (Garfield Park).

Extensive improvements can well be made at these gardens. About 500,000 plants are annually propagated at the greenhouses for use in the summer and autumn decorations of the public parks. The beautiful water lilies and other aquatic plants used in many of the fountain basins are also propagated here.

The various structures are serviceable for the purposes for which they are used, and have been mainly erected by our own workmen at comparatively cheap cost; they are without ornamentation of any kind, and are maintained in repair by a small annual appropriation of $2,000. The buildings should be increased in number. A large palm house and subtropical plant house are especially needed. Greenhouse pits and cold frames are also required for the purpose of growing hardy herbaceous perennials, no plantings of which, of any magnitude, have as yet been made in any of the parks or other public gardens in Washington.

The nursery grounds of the gardens, exclusive of the ground occupied by the greenhouses, storehouses, sheds, roads, and walks, cover an area of about 4 acres, one-third of which is occupied by the greenhouse plantings for stock and hardy rose grounds. The remaining portion is thickly planted with young trees and hardy flowering shrubs, set out in rows ready for transplanting when required. This area is not sufficiently large to supply the tree and shrub plantings of the park extensions of the public grounds, and purchases are made of the varieties and character needed from commercial nurseries and wherever they can be found to supply deficiencies. It is hoped that in the near future, when the work of filling the Potomac Flats near the propagating gardens is completed, the nursery grounds may be extended so as to furnish abundant room for the purposes for which they are intended.

This office is frequently in receipt of requests for the loan of plants from the gardens for the use of churches, fairs, festivals, etc., and demands are constantly made for flowering and decorative plants for private purposes.

All such requests have to be declined, as either the loan or gift of any plants would be in violation of the following extract from the act of Congress approved June 20, 1878:

> *Provided*, That hereafter only such trees, shrubs, and plants shall be propagated at the greenhouses and nursery as are suitable for planting in the public reservations, to which purpose only the said productions of the greenhouses and nursery shall be applied.

After the annual spring planting in the parks is completed, it sometimes happens that there is a small surplus of bedding plants on hand. These are divided among such public reservations or institutions as the State, War, and Navy building, Marine Barracks, Washington Aqueduct grounds, Fort Myer Military Reservation, and various hospitals and orphan asylums. After these are supplied, should there still be a few such surplus plants remaining, they are given to whoever may ask for them.

RESERVATIONS NORTH OF PENNSYLVANIA AVENUE AND WEST OF THE CAPITOL.

This division of the city embraces all the public reservations located between First and Twenty-eighth streets west, and B street and Florida avenue north, the majority of which are in an advanced condition of improvement and require the constant attention of a force of skilled laborers for their proper maintenance.

It includes the highly improved parks known as Washington Circle, Rawlins Square, Du Pont Circle, Scott Circle, Lafayette Square, Franklin Square, Farragut Square, McPherson Square, Mount Vernon Square, Iowa Circle, Thomas Circle, Judiciary Square, and a number of other smaller highly improved reservations.

The labor required in the general care of these parks and park places has consisted mainly in mowing the lawn surface in the growing season, from April to November, about twice each month in the large parks and about once each week in the small and central parks and park places to keep the grass surface in a sightly condition; in edging and trimming margins of lawns to prevent unsightly growth of grass over gutter ways, and to preserve the outlines of roads and walks bordering them, which was required to be done usually after each mowing; in cleaning out the gutter ways and catch basins from deposits of sand, etc., to prevent the obstruction of drainage pipes, which was required to be done usually after each heavy rain storm, and occasionally after high windstorms during this period; in removing weed growth from gravel road and walk surfaces during spring and early summer months, and raking off the stones from the surface of the roads, caused by wearing and constant travel over the same, which was required to be done on an average of once in two months during this period, and raking and compactly rolling the surface of the walks to keep them in good condition after heavy rain storms during the summer and autumn months; in cutting out the deadwood from the large shade trees and heading back the old overgrown groups of shrubbery, and pruning into proper shape the dwarf ornamental flowering trees and shrubs after their season of flowering is over; in removing from infested trees and shrubs, cocoons of the basket caterpillars, and destroying the web nests of the processionary caterpillars, which hatch out during the hot months; in spraying the large American elms effected by the elm beetle in the several parks, with London purple, dissolved in water; in watering young trees and shrubs to promote their growth during the months of July, August, and September—this was required on an average of once each week during that period; in watering flower beds and borders in various improved reservations, which was required on an average of two or three times each week during the dry season—these flowers beds and borders were trimmed to keep them in proper shape twice each week during the summer months up to September 30; in removing weed growth from brick pavements bordering parks and park places, and gutter ways bordering roadways through the parks, as required during the summer and autumn months.

The asphalt and granolithic walks around and through the most highly improved parks and park places were regularly swept by the watchmen and their assistants, during the spring, summer, and autumn months; the fallen leaves on the lawn surfaces around and through the groups of trees and shrubbery were raked up from July 1 to November 30, and the leaves, rubbish, and brush gathered up during each week, during the spring, summer, and autumn months, were hauled to the nearest dump. The road surface in a portion of the grounds south of the Executive Mansion was sprinkled during the dry months to keep down the dust.

In the autumn of 1896 the summer decorative plants were removed from the flower beds in the parks in this division and the beds planted with spring flowering bulbs. In the spring of 1897 these bulbs were taken up and stored in the nursery for future use, and 116 beds planted with summer foliage and flowering plants.

The severe hurricane which visited this city on the night of September 29, 1896, did considerable damage to the trees in the parks in the northwest division. After this storm 235 cart loads of wood and branches were hauled from these parks to the dump; 55 trees were destroyed and had to be removed, 255 trees were badly damaged, and 319 trees were slightly damaged. All the broken branches and stumps in the large shade trees that could be reached were sawed off.

The damage to the trees by this hurricane was mainly to the silver poplars, silver maples, and the ash, although the evergreens suffered to a limited extent.

In Du Pont Circle (Reservation No. 60) the drinking fountains were repaired and 584.09 square yards of the asphalt walk surface was resurfaced; the watchman's lodge, which for many years has stood at the northeast corner of the Executive Mansion grounds within the iron fence and occupied by a watchman employed by the Treasury Department, was transferred to this office in June by the officials of that Department; it was immediately removed to Du Pont Circle, placed in position on the east side of the park, and thoroughly repaired.

In Farragut Square (Reservation No. 12) the drinking fountains were repaired and 348.63 square yards of the asphalt walk surface was resurfaced.

In Franklin Park the water-closets were overhauled, cleaned, and provided with new fixtures where needed and a cement floor laid. A terra-cotta sewer was replaced by an iron-pipe sewer. Stoppages in waste pipe of fountain were removed. Almost all the woodwork of watchman's lodge repainted and the ceiling calcimined. The most worn portions of the gravel walks in this park were resurfaced, about 37 cubic yards of gravel having been used for the purpose. The water-closet in the watchman's lodge was enlarged, the necessary space being taken from the lodge room. A closet, provided with doors, for storing small tools was made in the lodge and a doorway cut through the partition, and a door hung for an entrance into the tool room at the back of the lodges. The old unsightly wire around the flower border, inclosing the fountain basin, was removed and replaced with a new fence. Five flower beds, that were too much shaded by the heavy growth of trees in this park, were abandoned and their surfaces sodded over. Thirty-four and two-hundredths square yards of asphalt walk surface in this park were resurfaced. One hundred and eighty-two and two-thirds square yards of sod was used in this park.

In Hancock Place (Reservation No. 36), Pennsylvania avenue between Seventh and Eighth streets west, the statue of Gen. Winfield Scott Hancock was dedicated in May, 1896, and shortly after the beginning of the present fiscal year work for the improvement of the grounds, under the appropriation of $3,000 made in the sundry civil appropriation act, approved June 11, 1896, was commenced. These improvements have been completed, as follows: The old stone curbing along the Pennsylvania avenue and Seventh street sides of the reservation was removed and a low wall of rough ashlar stone, surmounted with a neat granite coping, was constructed in its place. The grade of the reservation along those sides was raised to the level of the top of this wall and for a sufficient distance back therefrom, and two low flights of granite steps, flanked on either side with granite pier posts, were constructed on the east side and south side for access from the sidewalks. New walks were constructed through the reservation and paved with asphalt, and a large circle was laid off at the apex of the reservation, inclosed with a granite curbing and planted with suitable plants. The margins of the walks were sodded, the lawn surface seeded, and the grounds ornamented by planting the following trees, shrubs, and plants: One hundred and twenty-seven evergreens, 152 yucca plants, 282 deciduous shrubs, 2 weeping mulberries, 2 magnolia trees, 2 weeping elms, and 275 English ivy plants. The area of walk surface in this reservation which was paved with asphalt was 258 square yards. Three hundred and nine square yards of sod was used in the reservation.

The drinking fountain in Iowa Circle (Reservation No. 153), was repaired.

In Judiciary Park a new standpipe was put in place of one burst by frost and the stoppage in sewer removed. The gravel was removed from the surface of the roadway fronting the center entrance to the Pension Office building and replaced with an asphalt pavement, the area covered amounting to 551.44 square yards. The gravel removed from this roadway was used in repairing worn portions of other gravel roadways through the park. The gravel roadway on the line of F street was repaired from the entrance at Fifth street to where it joins that part of the roadway which is surfaced with asphalt. Sixty-two cubic yards of gravel were used in these last-mentioned repairs. A plank walk 216 feet long and 4 feet wide was laid over the surface of the gravel walk, in bad condition, leading from Fourth and E streets to the east entrance of the court-house. A board walk 147 feet long and 4 feet wide was laid for the convenience of guests attending the inaugural ball in the Pension building, on each side of the temporary covered entrance to that building. This latter walk was removed after March 4, and the hard trodden-ground at the borders of the walks at the east entrance was spaded up and resodded. Sixty-six assorted flowering shrubs were planted at the west end and south fronts of the building where there were vacancies in the groups of shrubbery. The granite-block pavement around the entrance to the coal vault at the west end of the building was raised and a new wire guard fence was placed around the border inclosing the fountain basin at south front. One hundred and thirty-seven and fifty-two one-hundredths square yards of asphalt walks in this park was resurfaced.

In Lafayette Square the iron fence around Jackson's statue was painted, water-closets overhauled, cleaned, and provided with cement floor and new fixtures. A stoppage in the 8-inch sewer was removed at northeast corner of the park. Drinking fountains were put in good order. The water-closets were painted.

One hundred and seventy-eight and eight one-hundredths square yards of the asphalt walk surface in this park was resurfaced.

One hundred and nine and four-ninths square yards of sod was used in resodding worn portions of the lawn surfaces in this park.

In Mount Vernon Square the fountain works were repaired and the drinking fountain put in good order. A new walk was cut out around the base of the fountain basin in this park, also four short walks leading into it from surrounding walks, and upon these walks asphalt pavement was laid, the area covered amounting to 109.96 square yards.

Four hundred and sixty-three linear feet of new plank walk 3 feet wide was laid during the winter over gravel walks that were in bad condition, and fifty iron guards were placed along the grassed margins of walks where pedestrians were making unsightly trespass paths, to prevent the same.

In the President's Park (south of the Treasury Department, Executive Mansion grounds, and State Department) the most worn portions of the road surface were given a good covering of gravel and thoroughly rolled; 208 cubic yards of gravel was used in these repairs. The ground over bare places on the surface of the lawn of the ellipse was loosened and sown with lawn grass seed. The ground around the young trees and shrubbery was spaded up; a short gravel walk was made at the northeast corner of the grounds, from the present gravel walk out to the main roadway, to complete this thoroughfare. The soil taken out of the bed of this walk was utilized in filling up the low ground that had settled down over the line of the new sewer which crosses these grounds, to bring it up to the grade of the surrounding ground. Three places in the stone gutter ways, about 200 linear feet, which had settled down where this new sewer crosses them, were lifted and repaved to grade; the ground alongside of the gravel walk leading in from Fifteenth street, where there was a wide trespass, was loosened and sown with lawn-grass seed and a wire fence placed along the line of the walk to guard the same; the ground along the border of the walk leading from the main roadway out to Seventeenth street, where there was also a wide trespass, was loosened and sown with lawn grass seed and a wire fence placed along the border of the walk. A barricade was removed from each end of the gravel walk leading out from the main roadway to Seventeenth street on line with D street, and three iron posts placed at each end to prevent teams or wagons from passing over it, which they had formerly done. Six signs were placed at prominent places of travel around the ellipse, prohibiting the making of trespasses across the same; two of the gravel walks that were very much worn, at the south side of these grounds, were resurfaced; the brick apron at the entrance of roadway leading from Seventeenth street into the grounds, which was worn in holes and in bad condition, was repaved. A quantity of overgrown and unsightly shrubs were removed and 88 assorted flowering shrubs planted in their places; 76 assorted flowering shrubs and 3 deciduous trees were planted in vacant spaces around the belt of trees and shrubbery at the President's stable.

A special effort was made in October, 1896, to prevent the further destruction of the lawn of the ellipse by trespass paths and to carry out existing law and police regulations in regard to speeding bicycles on the road around the ellipse which, owing to the illness of the watchman at this park, was being used by bicyclists for "scorching." This had been carried so far that complaints were received from pedestrians and drivers of teams. Information was received that one of the police force of the city, so far from aiding to stop the practice of "scorching," actually took part in violating the regulations which it is presumed it was his duty to carry out. Four of the United States watchmen were withdrawn from other parks and directed to break up, if possible, the existing evil. As a result three bicyclists were arrested during the month. When brought before the court they were discharged on their personal bonds. The evil has continued more or less, however, during the present spring, although arrests are made from time to time. It is highly desirable that there should be legislation on the subject which will make the punishment sufficiently severe to break up this selfish and annoying nuisance. This matter is referred to later under the heading of "Legislation."

By authority of the joint resolution approved February 13, 1896 (No. 16), these grounds were occupied by the Christian Endeavor convention during the month of July, 1896. Three mammoth tents and a number of smaller ones were erected, and electric-light poles put up on the ellipse. The beautiful lawn was cut up by wagons and horsemen, and trampled by thousands of people, damaging it considerably. At the close of the convention the committee in charge promptly removed the tents and poles, cleared up all refuse, and restored the grounds as nearly as possible to their former condition, without expense to the United States.

Heretofore, on all occasions where the lawn of this beautiful ellipse has been used for ceremonies of this character, it has been apparent that a wide walk around the parade would be a desirable feature and afford safe standing room, out of the way of passing vehicles, for spectators, as well as a path for pedestrians visiting the locality.

With this object in view it is suggested that an asphalt walk 15 feet wide be constructed around the outer portion of the ellipse, separating it from the carriage road by a parking 30 feet wide.

The American elm trees now bordering the parade would afford partial shade to this walk, as well as to the roadway. At all of the principal outlets of the park to surrounding streets wide walk openings would be made to connect with these roads for the convenience of the public.

It is estimated that the approximate cost of this walk, with its approaches, necessary drains, drain lodges, etc., will be $10,500.

In Washington Circle (Reservation No. 26) new connections were made in drinking fountain and 58.76 square yards of the asphalt walk surface was resurfaced.

In Reservation No. 32 (south side of Pennsylvania avenue between Thirteen-and-a-half and Fourteenth streets west) the fountain basin recently constructed was lined with Portland cement to complete it for holding water and 11 ornamental evergreens and 3 magnolia grandiflora trees were planted.

In Reservation No. 33 (Pennsylvania avenue, Thirteenth and E streets northwest) the wire fencing around the flower beds and the fountain basin, which had broken down and become very unsightly, was removed.

In Reservation No. 70 (at Massachusetts avenue, Ninth, and K streets northwest) the inclosing iron fence which was erected many years since by the owner of the adjoining house, thus apparently including the grounds as a part of his own premises, was removed during the month of June by the agent of the present owner at the request of this office, and the reservation will now be cared for by the employees of the public grounds.

In Reservation No. 72 (at Massachusetts avenue, Sixth and I streets northwest) six large deciduous shade trees, 2 evergreens, and 13 unsightly shrubs were removed, a bad trespass path across the lawn broken up and sown in grass seed, and two signs prohibiting further trespassing placed in position at each side of the reservation.

At Reservation No. 74 (Massachusetts avenue, Fifth and I streets northwest) 108.7 square yards of asphalt pavement was laid upon the surface of the gravel walks, and the ground along the margins of the new walks leveled up with soil, seeded down, and restored to the lawn surface. A border of sod was laid along the margins of the new walks, and 20 unsightly shrubs and 1 evergreen were removed.

At Reservation No. 144 (New Hampshire avenue, Seventeenth and S streets northwest) the ground was cleaned up; 288 assorted flowering shrubs, 25 yucca plants, and 1 weeping mulberry tree planted; a flower vase placed in the center of the reservation; 8 park settees placed in position, and the ground along the borders of the walks where the grass had been worn off by pedestrians resodded, 63½ square yards of sod having been used for the purpose.

At Reservation No. 174 (New York avenue and I street, between Tenth and Eleventh streets northwest) an asphalt pavement covering an area of 214.48 square yards was laid upon the surface of the gravel walks, the bare ground along the margins of the walks over about one-half of the reservation loosened, the grade raised with fresh soil, the ground sown down in grass seed, and a border of sod laid along the margins of the new walks. One large elm tree and 8 unsightly shrubs were removed.

At Reservations Nos. 193 and 194 (intersection of New Jersey avenue, Second and I streets northwest), in the former slight repairs were made to the gravel walks; in the latter the gravel walks were entirely resurfaced, 22 cart loads of gravel having been used for the purpose.

Much work is still required in this beautiful section of the city. The parks should all be surrounded by granite curbings; all walks and roads should be of asphalt; the roads should have curbings and be properly drained. This is particularly true of Judiciary Park, which covers an area of about 20 acres, and the gravel roads of which are almost as much traveled as are the adjacent streets and equally subject to wear from heavily loaded teams, rendering it very difficult to maintain them in good condition for travel during the winter. The first cost of asphalt roads and granite curbings would of course be approximately large, but the subsequent saving in the cost of their maintenance would, in the course of a few years, more than compensate for the original outlay.

In all the parks the lawns, tree and shrub plantings should be well cared for and maintained in the highest degree of excellence. This will necessitate from time to time not only considerable trimming, but the removal of occasional trees and shrubs, where too thickly planted, to secure future benefits not apparent to the casual observer.

RESERVATIONS OCCUPIED FOR INAUGURAL PURPOSES.

Under the authority granted by the joint resolution of Congress (No. 8) approved February 6, 1897, permission was granted by the Secretary of War to the executive committee on the inaugural ceremonies to erect temporary viewing stands on the reservations along Pennsylvania avenue between Seventh and Seventeenth streets from which to view the parade. These stands were taken down and the materials removed in due time after the 4th of March. The débris remaining after the removal of these stands was cleaned up and carted away by the employees under this office.

Hancock Place at Pennyslvania avenue and Seventh street suffered more damage from this temporary occupation than any of the other reservations, because of the newness of the improvements therein, which had only been completed during the previous fall. The work which was necessary to be done to repair this damage and which was done by this office was as follows: The hard-trodden ground over the surface of this reservation was spaded up and resown in grass seed; 13 evergreens, 141 yucca plants, and 2 deciduous magnolia trees were planted, worn portion of the circular mound around the statue of General Hancock was spaded up and resodded, and the ground around the groups of evergreens and young flowering shrubs was spaded.

RESERVATIONS IN THE SOUTHWEST DIVISION.

This division of the public grounds embraces the area lying between First and Seventeenth streets west and B street north, and includes the large and important parks known as Henry and Seaton parks, the Smithsonian Grounds, and Monument Grounds.

The work performed in the general care of these parks and park places during the year has been about as follows: The lawns at park places and the most prominent lawns in larger parks were mown and raked weekly during the growing season. The remaining and larger part of lawns were mown and raked about three times during the same period. The young trees and shrubbery were spaded around and watered during the dry season. The flower beds were scuffled, weeded, watered, and kept trimmed to shape. The asphalt walks and roadways and flagstone walks were swept and maintained in cleanly condition. The catch basins were cleaned and brick and stone gutters weeded and cleaned as needed, the loose stone raked from roadways in piles, and the caterpillars removed from trees so infested and burned. The margins of lawns were edged and weed growth removed from all gravel roadways and walks. The deadwood and broken branches were removed from some of the trees and shrubs, and the broken branches blown from trees were collected in piles and removed from the parks. The board walks were repaired as needed. The lawn surface on angles at Monument Grounds and around statues was covered with compost, 25 cart loads being used. The flower beds were torn out in the fall, plants to be saved sent to the greenhouse, and remainder sent to dump. The large bed and two smaller beds near the entrance to the National Museum were prepared for planting, the large bed being planted with chrysanthemums and two smaller beds planted with hyacinths, tulip and crocus bulbs. The smaller beds were covered with manure as a protection during winter months. The beds not planted in fall were rough spaded. The plants and bulbs were removed from the beds in the spring and all beds manured and spaded. The park seats needing it were refastened. The leaves were raked from roadways, walks, and lawns during the fall months. There were about 25 dead trees removed from these parks.

The following damage was done to the trees in the parks in this division by the storm of September 29: Sixty-seven trees were uprooted or so badly broken as to require their removal; 232 trees were badly damaged and 222 slightly damaged; 352 cart loads of stumps and branches were hauled from the parks to the dump.

Henry and Seaton parks have an aggregate area of about 34 acres, mainly laid out in lawn surfaces, the planting of which has not yet been completed; about 3 acres only are covered by gravel road and walk surfaces. They extend from the Smithsonian Grounds to the Botanic Gardens, which in their turn join the United States Capitol Grounds, and complete the chain of parks extending from the Executive Mansion to the Capitol. In Henry Park the water service was extended during the year by laying 152 feet of 1¼-inch galvanized-iron pipe; 58 repaired park settees were hauled from the nursery shops and placed in these parks; gravel roadways in Henry Park were repaired; five new flower beds were made; bare places in the lawns on each side of the roadway near the bridge over Sixth street were resodded, and stake-and-wire fences erected to prevent further trespassing. In Seaton Park the water mains were repaired and calked, and the gravel roadways repaired, 149 cart loads of gravel being used for the purpose. A plank walk 150 feet long and 2 feet wide was laid over the short gravel walk running from the roadway in the center of the park toward Missouri avenue.

The Smithsonian Park Grounds, located on the Mall nearly midway between the White House and the Capitol, and between the business sections of North and South Washington, is one of the most popular park resorts of the city. It contains within its boundaries the Smithsonian Institution, the National Museum, and the Army Medical Museum, all of which attract many visitors. The area of the park is about 58 acres, the greater portion of which is laid out in lawn surfaces, about 9 acres being devoted to roads and walks. In addition to the work done during the year for its maintenance, 150 feet of 4-inch iron sewer pipe was put in to drain the east drinking fountain, and 25 feet of 6-inch sewer laid to drain the trap near the Ninth street entrance. An asphalt walk covering an area of 42.64 square yards was constructed in the rear of the statue of Dr. Gross, and the soil removed in preparing for this new walk was used in grading around the pedestal of the statue, and the ground was then sodded. Six hundred and ninety-four and thirteen one-hundredths square yards of the asphalt roadways in this park were repaired and resurfaced, and bare places in the lawns near the Henry statue and the border around a large flower bed were resodded. Three hundred and forty-six and two-thirds square yards of sod were used in this park. Ten evergreen trees were planted near the Dr. Gross statue. Seventeen iron posts were set at each end of the roadway in rear of the Smithsonian building to prevent the passage of vehicles over the roadway. The trees uprooted by the storm of September 29 were removed from the park.

At the request of the Secretary of the Smithsonian Institution the road immediately south of that building was closed to wagon travel. The Secretary also requested that the asphalt road between the National Museum and the Smithsonian building should be similarly closed, for the reason that wagon travel disturbed the delicate instruments in the astrophysical observatory. No action toward closing this latter line of public travel has been taken by this office. The lawn surfaces of this park need renovation; they are planted with a great variety of deciduous and evergreen trees, many of them being the most perfect of their kind in the parks of this country. It is earnestly hoped that the entire appropriation requested for this park may be granted. On account of the constant passage of teams—many of them heavily laden—over the gravel roads, it is difficult to maintain them in good condition during the winter and early spring. About nine years since the construction of asphalt pavements was commenced and has continued from year to year, as far as available funds would admit, until now, out of an area of about 45,000 square yards of road and walk surfaces, over 15,000 square yards are of asphalt.

The Washington Monument Park, covering an area of about 78 acres, is the site of the Washington Monument. During the year every effort has been made to maintain the improved portion of the grounds in as good order as possible, and to continue the improvements so far as the limited funds available would permit. The standpipes were repaired and 140 feet of 6-inch terra cotta sewer were laid to drain the road near Fifteenth street entrance. The improvement of the northeast part of the grounds was continued. Eight hundred and fifty-seven linear feet of new gravel roadway 30 feet in width was constructed. Including the foundation this roadway is 1 foot in depth, and 563 cart loads of broken stone and brick and 774 cart loads of gravel were used in its construction. The flagstone pavement at the entrance to these roadways on B street were removed the width of the roadway, 49 feet of curb set, and 64 square yards of cobblestone pavement laid at the entrance; 146 cart loads of soil were used in grading the borders of the new roadways, and the borders were then sodded; 490 square yards of sod were used. A drain trap was built at the intersection of these roadways, and 135 feet of drain pipe laid to connect it with the sewer; 17 trees and 205 shrubs were planted, and the old roadways in the grounds were repaired with gravel. A large pile of broken stone and brick and gravel, 1,806 cart loads in all, which was piled in the northeast part of the grounds near the fence along B street, was removed therefrom and hauled to the storage grounds on the Potomac Flats, thus completing the grading of the Monument grounds.

It is again earnestly recommended that the electric-light system inaugurated in 1889 in the grounds south of the White House be extended throughout this park. There is now no method of artificial illumination between B street north and the Propagating Gardens south of the Monument, and Fourteenth and Seventeenth streets, and in the interest of morality and for the protection of persons necessarily crossing these grounds at night lights are necessary. A complete detailed statement of the plan of improvement projected for this great reservation was submitted in annual report for the fiscal year ending June 30, 1893.

At Reservations 111 and 113 (situated, the first on Virginia avenue between Eleventh and Twelfth streets west, the second at the intersection of Virginia and Maryland avenues between Seventh and Ninth streets SW.) the iron posts of the inclosing fences which were out of line were straightened and rammed, and the old walk across Reservation 113 removed and a new board walk 100 feet long and 3 feet wide constructed.

RESERVATIONS EAST AND SOUTH OF THE CAPITOL.

This division of the city includes within its limits the highly improved reservations known as Lincoln, Garfield, Folger, Stanton, and Marion parks.

In all of these reservations, as well as in the smaller improved parks, the lawns were mown and raked, gravel walks repaired, the roadways and walks hoed and raked, and the lawns bordering them edged, all gutters in and around the reservations and parks maintained in good condition, sewer traps kept clean, and refuse carted away. During the summer months all flower beds were regularly trimmed and watered; in the fall the beds were cleared of summer plants and spaded, and 13 planted with spring-flowering bulbs; the beds were inclosed with wire fencing to protect the plants from dogs, said fences being repaired or removed as they became broken or unsightly. In the fall the water lilies were removed from the fountains and hauled to the nursery, and the fountain basins cleaned out for the winter. Decayed wood was removed from the trees, bag worms were collected from the arborvitæs, and caterpillars removed from the trees and destroyed. During the dry season the bulbs and small trees were frequently watered. Board walks were laid in wet and soft places on gravel walks in Folger, Marion, Stanton, and Garfield parks. Metal caps were placed on the fence posts where needed; 155 cart loads of gravel were used in repairs to walks and roadways in Garfield, Lincoln, Folger, and Marion parks and reservation First street and Maryland avenue NE. Fences to prevent trespass were put up where needed in Garfield, Folger, and Marion parks.

In May and June 50 flower beds in the reservations in this division were planted with summer blooming and decorative plants, and goldfish were placed in the fountain basins in Folger and Stanton parks.

The damage resulting from the storm of September 29, 1896, was: Total number of trees slightly damaged, 86, distributed as follows: Lincoln, 48; Garfield, 18; Folger, 10; Stanton, 9, and Marion, 1. Total number badly damaged, 54, as follows: Garfield, 23; Lincoln, 21; Stanton, 5; Marion, 4, and Folger, 1. In Garfield Park 2 small trees were blown down.

The location of the water plug in the reservation at Eighth street and Pennsylvania avenue southeast was changed.

In the reservation at First street and Massachusetts avenue northeast a new stopcock pipe was put in and the jet and waste pipe of fountain repaired.

In Folger Park (reservation 16) the walks were repaired; 2 decaying trees were removed, and 1 box settee for papers and trash was placed in position.

In Garfield Park 12 magnolias were planted and mulching placed around the same; one small sewer trap was constructed; two leaking valves were repaired; the tool house was repaired, the roof painted, and the house whitewashed inside and out with yellow ochre; the roof of the closet was also repaired.

In Lincoln Park the drinking fountain and the lodge house were repaired and the water-closet painted; 10 fast-decaying trees were removed, the holes filled up, and sodded; three 8-foot gravel walks were made, each 42 feet in length, one leading to the East Capitol street entrance on the east side of the park, and one each to the north and south to connect with Twelfth street; 623.37 square yards of asphalt was laid in the walks leading from the northwest to the southwest entrance, from northeast to the northern entrance, and from the southern to the western entrance; six magnolia trees were planted; two flower beds were made and planted with chrysanthemums, the sod taken from same being used in repairs to lawns in other places; the lawns bordering the gravel walks were resodded where needed and soil spread in low places about the same where trees were removed, the places being afterwards sown with rye and grass seed; the lodge house was repaired and its roof and two drinking fountains were painted; the closets were given needed repairs and painted; electric lamp-posts were put up in the park and 17 of the gas lamps discontinued.

In Marion Park (reservation No. 18) the roadways and walks were repaired. Four large stones to protect the curbing around the mound were sunk in the roadway, and one box settee for paper and trash was placed in position.

In Sherman Park (reservation No. 224) the fountain jet was stolen. This was replaced and the fountain works repaired.

In Stanton Park (reservation No. 15) 346.27 square yards of asphalt were laid in the walk leading from the northeast entrance to the southwest entrance on the north side of mound; one decaying tree was removed; one box settee for paper and other trash was placed in position; the Greene equestrian statue was cleaned, and the fountain pipes repaired.

The final improvements projected for Garfield Park, covering an area of about 24 acres, are nearing completion. The main gravel road through this park, leading to Virginia avenue, is used as a thoroughfare for heavy teams, which renders it difficult to maintain it in good condition during the winter season.

It is regretted that the reduced appropriations will prevent the continuance of any extensive improvements, the amount available being not more than sufficient to maintain in good order the roads, walks, gutters, drains, lawn surfaces, trees, shrubs, and other improvements.

Stanton, Folger, and Marion parks are highly improved, planted with choice specimens of trees and shrubs, and laid out with gravel paths. There are fountains in Folger and Stanton parks, and Stanton Park contains the bronze equestrian statue of General Greene. The gravel walks in these reservations should be covered with asphalt.

In addition to these parks there are 28 small public spaces which have been partly improved and planted, and about 100 similar spaces at the intersections of streets and avenues yet unimproved.

The increased prosperity of this section of our city and the large number of private improvements in progress demand that still more attention be given to beautifying the public spaces, and increased appropriations are earnestly recommended for this purpose.

SETTEES, TOOLS, MANURE, REPAIR OF POST-AND-CHAIN FENCES, AND REMOVING SNOW AND ICE.

During the year 330 park settees were repaired and 345 painted. All settees in the parks were examined and those found loose were refastened to the ground with stakes and wire.

Repairs were made to lawn mowers, wheelbarrows, and miscellaneous tools; edged tools were sharpened and put in good order, and new tools purchased from time to time when necessary.

About 1,160 cubic yards of manure, 270 cubic yards of soil for compost, 100 bushels of air-slaked lime, and 260 cubic yards of potting sod were purchased.

About 1,250 cubic yards of compost was prepared and used in top-dressing the lawns of various parks, and in mulching trees and shrubs; and about 300 cubic yards of well-rotted manure were used in enriching flower beds; potting compost was also made for use in growing plants in the greenhouses.

The post-and-chain fences around the boundaries of the parks and park places were examined, new iron caps placed upon the posts where needed, all posts out of line straightened, and all loose posts securely reset. Broken chains were repaired with new links and refastened to posts where required with new iron pins.

The snow and ice were removed as rapidly as possible from the paths and sidewalks through and around various reservations; the snow storms were not heavy during the winter and about $557, or nearly one-half of the appropriation, was returned to the Treasury.

WATER PIPES AND FIRE PLUGS, AND CARE AND REPAIR OF FOUNTAINS IN THE PARKS.

Repairs have been made to the water pipes and valves from time to time when necessary. In the autumn water was shut off from the various parks and 252 hose valves removed and stored at the nursery grounds. In the spring these valves were replaced in the parks. During the year the water pipes were extended 240 feet and two new gate valves placed in position.

There are 21 fountains with basins in charge of this office, located as follows: Executive Mansion grounds, 3; Lincoln Square, 2; Stanton Square, 2; Rawlins Square, 2; and 1 each in Folger Square, Judiciary Square, Mount Vernon Square, Franklin Square, and the reservations at Massachusetts avenue and Twentieth street, New York avenue and

Third street, Pennsylvania avenue and Ninteenth street, Pennsylvania avenue and Thirteenth street, Pennsylvania avenue and Fourteenth street, Pennsylvania avenue and Twenty-first street, Pennsylvania avenue and Twenty-eighth street, and Delaware avenue and First street, northeast. Five of the fountains were painted one and two coats as needed, 120 feet of new 4-inch sewer pipe was laid to drain fountain basins and new overflow pipes and brass plates placed in the basins of six fountains.

With a few exceptions the jets are of a very simple character.

There are 24 drinking fountains in the various parks. These were repaired where necessary, properly painted, dippers retinned, and chains renewed. The fountain basins were properly cleaned and thoroughly repaired before water was turned on in the spring.

In the autumn the water was turned off in the fountains, 20 jets removed and stored at the nursery shops. These jets were repaired where necessary during the winter and replaced upon the fountains in the spring.

FOUNTAINS.

A special plea is made for the beginning of a scheme of fountains, to be gradually brought, as years go by, to liberal abundance and beauty.

Of all the capitals of the world our own Washington is in many respects the most beautiful; but it is sadly deficient in fountains. Nothing makes a city so attractive, both to citizens and strangers, especially in this latitude, as an abundance of bubbling, sparkling water. In all the beautiful Smithsonian and Monument grounds, in Henry and Seaton parks, in Garfield Park, there is not a single beautiful fountain, and in all the District there is not one large, superb electrically lighted fountain, such as the capital of this nation should possess, to be talked of the world over. Yet other cities have such fountains.

It is true that much water is needed for fountains, and if that were to prove an insurmountable obstacle it might be obviated by building fountains with pumps, thus using the same water over and over again. Such pumps can be operated by electricity, which can also be used to make beautiful illuminations at night.

Ten thousand dollars, to be expended in eight fountains of various sizes, supplied by the Potomac mains, would enable a striking addition to be made to the beauty of the nation's parks in Washington and add greatly to the pleasure and comfort of citizens and visitors.

PAINTING WATCHMEN'S LODGES, IRON FENCES, VASES, LAMPS, AND LAMP-POSTS.

There are 12 watchmen's lodges, 405 lamps, 21 vases, a large number of post-and-chain fences, the high iron fence around the Executive Mansion and the iron fences around the greenhouses and nurseries under charge of this office.

The following painting has been done during the year:

Posts and chains painted one coat	1,996
Posts and chains painted two coats	715
Lamps and lamp-posts	83
Vases	10

LIGHTING THE PUBLIC GROUNDS.

The following parks are lighted by electricity: President's Park, 7 lights; Lafayette Park, 6 lights; Franklin Park, 9 lights; Judiciary Park, 9 lights; Lincoln Park, 8 lights.

The two north entrances to the Executive Mansion grounds are also illuminated with electric arc lights, one at each entrance.

The electric lights in Lafayette, Franklin, Judiciary, and Lincoln parks were installed during the present fiscal year, as is more fully set forth in another part of this report. Immediately after these electric lights were put into service 63 gas lamps in those parks were discontinued.

It is earnestly hoped that this system will be extended to the Executive Mansion grounds, the Monument and Smithsonian grounds, and to the various improved parks throughout the city.

There are 401 ordinary gas lamps, with 454 burners, and 2 arc gas lamps belonging to this department. The arc lamps were discontinued in 1894, they being rendered unnecessary by the brilliancy of the electric lights in the neighboring streets. Two gas-lamp posts and lamps were taken down during the year, being in places selected for arc electric lights.

The number of lamps not connected with meters lighted during the year and paid for by this department was as follows:

July 1, 1896, to February, 1897	318
March, 1897, to June 30, 1897	255

Each of these lamps burned about three thousand hours and consumed about 18,000 cubic feet of gas.

In addition to these there are 71 burners within the Executive Mansion grounds connected with the meters of the mansion.

Gas pipe has been run to and gas pipe and brackets placed in the watchmen's lodges in Judiciary, Mount Vernon, Lafayette, Stanton, Smithsonian, and Seaton parks and Iowa, Washington, and Dupont circles. In the Smithsonian grounds 48 old and unserviceable gas lanterns have been removed and replaced with new boulevard lamps, and boulevard lamps of large size have been placed on the posts of the drinking fountains in Franklin, McPherson and Mount Vernon parks and Iowa Circle.

Ten lamps and lamp-posts in the Executive Mansion grounds were painted and bronzed, and the gas fixtures throughout the grounds kept clean and in good order.

INSTALLATION OF ELECTRIC LIGHTS IN LAFAYETTE, FRANKLIN, JUDICIARY, AND LINCOLN PARKS.

In the sundry civil appropriation act approved June 11, 1896, it was provided:

> For electric lights for three hundred and sixty-five nights for not exceeding thirty-two posts in Lafayette, Franklin, Judiciary, and Lincoln parks, at twenty-eight cents per light per night, three thousand two hundred and seventy dollars and forty cents: *Provided*, That all wires shall be placed underground, and that the conduits, wires, lamp-posts complete shall be furnished by the electric-light company without expense to the United States, and that twenty-eight cents per lamp per night shall cover the entire cost to the United States of lighting and maintaining in good order each electric light in the parks mentioned.

On June 25, 1896, proposals were invited by this office for arc lights in the parks mentioned as follows: Lafayette Park, 6 lights; Judiciary Park, 9 lights; Franklin Park, 9 lights; Lincoln Park, 8 lights.

Bids were received and opened on July 2, 1896, as follows: Potomac Electric Power Company, 27 cents per lamp per night; United States Electric Lighting Company, 28 cents per lamp per night.

These bids were submitted to the Chief of Engineers on July 7, 1896, with the remark that the United States Electric Lighting Company had its conduits and cables laid so that easy connection could be made with the first three parks mentioned and also had conduits and cables within six squares of Lincoln Park; that the Potomac Electric Power Company, the lowest bidder, had its central power station located in Georgetown, and had no conduits or cables laid east of Rock Creek. It was therefore recommended that the matter be held in abeyance until it was ascertained whether the District Commissioners could, under the law, grant permits to lay additional conduits and cables in the public streets. On August 6 the Commissioners addressed a letter to this office stating that a majority of their board had decided they could issue a permit to lay conduits and cables to either of the electric-light companies operating in the District which should secure the contract for lighting the public parks. This view, however, was dissented from by a minority of the board (its president), as well as by the attorney for the Commissioners, who claimed that under existing statutes and decisions of the courts the Commissioners had not the power to grant permits to the Potomac Electric Power Company to lay underground conduits east of Rock Creek. As there were well-founded rumors that in case a permit was granted to the Potomac Company the United States Electric Lighting Company would go to the courts for an injunction, and as this office was anxious to avoid the annoyances incident to delay arising from a long-continued action in the courts, the communication of the Commissioners was on August 8 submitted to the Chief of Engineers with the request that the opinion of the Attorney-General be obtained as to the power of the Commissioners to grant permits to the Potomac Electric Power Company to lay conduits in the streets east of Rock Creek.

On August 22 a communication was received from the Acting Attorney-General of the United States, stating that he was informed that the same question had arisen under other provisions of the appropriation acts for the same year, and that the question was then before the supreme court of the District of Columbia in an injunction suit brought by the United States Electric Lighting Company; that while strongly inclined to concur in the conclusions of the president of the Board of Commissioners and the attorney for the District of Columbia, that the Potomac Company was without the authority claimed, he thought it more advisable to await the decision of the court before definitely answering the inquiry.

On December 18, 1896, the officer in charge of this office addressed a communication to the Chief of Engineers, stating that he was informed that the injunction against the Commissioners had been dissolved; that the court of appeals had declined to reverse the decision in the matter; that the contract for lighting streets had been awarded by the Commissioners to the Potomac Electric Power Company, and recommending that the contract for lighting the four parks be awarded to the Potomac Electric Power Company, the lowest bidder.

On December 21, 1896, the Chief of Engineers authorized the award of contract to the Potomac Company, and on December 26 the contract between that company and this office was executed. On January 13, 1897, the company was informed that as soon as their conduits reached the parks authority would be given them to excavate in the parks and continue the conduits to the positions selected for the lamps.

On January 16, 1897, this office addressed the Chief of Engineers, stating that the Senate of the United States had taken up the subject, and was investigating the question of authority of the Commissioners to permit subways to be laid; that as there was a possibility of Congressional action prohibiting for the present further excavations and subways, it was recommended that authority to open trenches in the parks for subways be not granted until Congress either by direct action or by lack of action during the then present session indicated its wishes in the matter. This recommendation was approved by the Chief of Engineers January 16. On January 29, 1897, it was recommended to the Chief of Engineers that in case Congress took no action by February 15, and there was no prospect of immediate action, the company be authorized to enter the parks and lay conduits and erect posts. This recommendation was approved by the Chief of Engineers February 3, and on February 15 the Potomac Company was authorized to enter the parks with their subways and cables, and to erect the lamps as provided by their contract.

The company immediately proceeded with and completed their work, and the parks were lighted on the following dates:

Lafayette Park (6 lamps)	February 18, 1897
Franklin Park (9 lamps)	February 20, 1897
Judiciary Park (9 lamps)	February 25, 1897
Lincoln Park (8 lamps)	March 3, 1897

The lighting of these parks by electricity rendered the lighting of the gas lamps in them no longer necessary, and their lighting was discontinued as follows:

Lafayette Park, 6 gas lamps discontinued, leaving 2 lighted.
Franklin Park, 12 gas lamps discontinued (entire number in the park).
Judiciary Park, 28 gas lamps discontinued, leaving 5 lighted.
Lincoln Park, 17 gas lamps discontinued, leaving 12 lighted.

The following tabulated statement shows the area of asphalt roadway and foot-walk pavement constructed and repaired during the year:

	New roadway.	Repairs to roadways.	New walks.	Repairs to walks.
	Sq. yards.	*Sq. yards.*	*Sq. yards.*	*Sq. yards.*
Judiciary Square	551.44			
Grounds south of Executive Mansion	283.07			
Grounds north of Executive Mansion		297.78		
Smithsonian Park		694.13		
Reservation, New York avenue, Tenth and Eleventh streets Northwest			214.48	
Reservation, Massachusetts avenue, Fifth and I streets Northwest			108.70	
Mount Vernon Square			109.96	
Smithsonian Grounds, Gross statue			42.64	
Lincoln Park			623.37	
Stanton Park			346.27	
Judiciary Park				137.52
Lafayette Park				178.08
Farragut Park				348.63
Yard of President's stable				81.50
Franklin Park				34.02
Du Pont Circle				584.09
Washington Circle				58.76
Hancock Place			258.66	
Total	834.51	991.91	1,704.08	1,872.60

DEPARTMENTAL TELEGRAPH LINE.

The telegraph lines now under control of this office are as follows:

The line of overhead wires consists of 78 poles, covering a distance of about 3½ miles, with a length of about 8 miles of wire. This line, starting from the State, War, and Navy building, runs to the Executive Mansion, thence to the Treasury Department, thence to G street, thence to Eighth street, thence to H street, thence to North Capitol street, and thence to the Capitol. Connected with it is one running from the Treasury Department along Fourteenth street to the Bureau of Engraving and Printing and Agricultural Department, and one down Fifth street to the Pension building. There are about 500 feet of 13-conductor Patterson cable running from the cable pole in the Capitol Grounds into the basement of the Senate, and 250 feet of 20-conductor cable running from the cable pole on the corner of Seventeenth and G streets into the State, War, and Navy building.

The underground cable laid by the Standard Underground Cable Company, of Pittsburg, in October, 1883, under permit granted for experimental purposes, and afterwards purchased by the Government in accordance with an act of Congress, has been useless for telegraphic operations since the winter of 1891–92, owing to the manner in which it was laid, being without any protection from the picks, etc., of workmen in the streets.

During the past year the main and local batteries received good attention and were maintained in good working order. All crosses and other obstructions were removed from the lines as soon as possible. All of the old and worn-out fixtures on roof of Treasury Department were removed and replaced with new. New fixtures were made, painted, and put on the roof of the Interior Department, and all old fixtures removed.

Fifty-five new chestnut poles from 50 to 80 feet in length were purceased, trimmed of knots, the sap shaved off, gained for cross-arms, and erected along the line in place of old poles which had become decayed and too short for further use, owing to the growth of trees along the streets. All the wire on the old poles which was in good condition was transferred to the new poles. Two miles of No. 12 copper conductor insulated wire and 1½ miles of No. 12 iron wire were used and put in place of old and worn-out wire which was of no use. All of the old and worn-out wire was removed from the old poles, and the old poles taken down and removed from the streets.

The old fixtures on the roof of the State, War, and Navy building were removed and replaced with new. A new 12-pin oak cross-arm was placed in position on the roof of the Executive Mansion, and all the wires running from the Treasury building to the Executive Mansion were pulled up and placed in proper position. The old cables on the roof of the Executive Mansion, which had been in use a number years and had become defective, were removed and replaced with new, with conductors sufficient to work the necessary circuit in the house, with a few extra in case of necessity. All the worn-out wire on the roof of the Treasury Department was removed and replaced with new. The wires on the roof of the Department of Justice were repaired and renewed where necessary. All of the old and worn-out wire running between the Interior Department and the Post-Office Department was removed and replaced with new. The old 6-wire cable running from the roof of Post-Office building to offices on second floor was removed and replaced with a new one.

The two wires running down Fifth street to make the necessary connections with the Pension Office were replaced with new No. 12 insulated wire. The lightning arresters in the cable pole on Capitol Grounds were taken out, repaired, cleaned, and replaced in good shape. All of the cables in basement of Capitol were carefully gone over and repaired where necessary and put in place. The instruments of the House of Representatives which were stored away in the office of Public Buildings and Grounds during the recess were repaired, cleaned, and put in place ready for the reassembling of Congress. Minor repairs were made to instruments, etc. The damage done by the storm of September 29, 1896, was very great, but not expensive, as it was the old line that suffered, which was at the time being done away with. It did not do any damage to the new line of poles which had just been erected. The wires which were all broken down from the old poles were allowed to remain so until transferred to the new poles.

The work of removing the telegraph office of the United States Senate from the second to the first floor was commenced in June; 200 feet of 10-wire cable was made and put in place ready to connect to the new instruments which are to be furnished by the Sergeant-at-Arms, at whose request the change was made.

The necessity for replacing the poles with a system of underground cables is so apparent that argument in its favor is unnecessary.

Estimates have been carefully prepared and submitted in previous years. The cost of the underground system will be $25,000, and the matter is presented for such action as Congress may deem best.

OLD RECORDS OF THE CITY OF WASHINGTON.

The first Commissioners were appointed by President Washington January 22, 1791, in conformity with act of Congress approved July 16, 1790. The duties of these Commissioners were transferred by various acts of Congress to their successors in office who were appointed from time to time by the President of the United States.

By act of Congress, approved March 2, 1867, the office of the Commissioner of Public Buildings and Grounds was abolished and the duties transferred to the Chief of Engineers, who thereby became the lawful successor of the original Commissioners appointed by President Washington in 1791, and the custodian of the original records of the District of Columbia.

The detailed history of these first original records is given in Annual Report for 1895. They are invaluable for reference in all real estate matters since all titles to real estate in the District of Columbia are more or less founded on them.

These old records and maps show in detail the various transactions of the first Commissioners in the original laying out of the city of Washington; the construction of the United States public buildings, and the sale of public lots between the years 1791 and 1867. A tabulated statement has been prepared showing every lot originally belonging to the United States as well as those which were sold by the General Government between the years 1791 and 1867.

This investigation has developed the fact that there are a number of squares and lots in different parts of the city of Washington for which there is no satisfactory evidence to show that the United States has ever received payment or granted deeds in fee simple.

In order to care for, index, patch up, and preserve these invaluable and irreparable documents, and to exhibit them to those properly entitled to consult them, and frequently to produce these records in court, the whole of one man's time is absolutely necessary and barely sufficient. The only employee of the office who could be utilized for this purpose was the one draftsman allowed on the office force, Mr. John Stewart, an earnest, faithful, and intelligent gentleman, who has now devoted nearly twenty years to the care and systematic assortment and investigation of these records. Meanwhile the office is practically without a draftsman, whose services are absolutely essential to the proper conduct of the regular business of the office.

Special attention is invited to this important matter, and it is urgently recommended that provision be made for the employment of a clerk to take charge of all these old records and of the very necessary labors connected with their care, and thus permit the only draftsman now allowed the office to attend to no less pressing and important work.

This request is the more confidently urged because of additional duties recently assigned to this office. All building plans in the city of Washington which contemplate projections beyond the building line are required by law to be approved by the Secretary of War. In order that the facts in each case may be thoroughly known, this office is very properly charged with investigation and report. But as Washington is now a city of over 275,000 inhabitants, and as these requests for projections average more than two a day throughout the year, it will readily be seen how absolutely necessary the services of another employee have become.

RESERVATIONS, WHICH ARE THE PROPERTY OF THE UNITED STATES OCCUPIED, IT IS BELIEVED, IN VIOLATION OF LAW.

[See map in Annual Report for 1894.]

The following reservations, claimed as the property of the United States, are now occupied, it is believed, without authority of law:

Reservations Nos. 113, 127, and 197, by the Baltimore and Potomac Railroad Company.

Reservation No. 226, by the Baltimore and Ohio Railroad Company. This reservation has been occupied since 1884 by a large derrick and used as a yard. No record of proper authority therefor can be found. The matter has time and again been reported in the annual reports of my predecessor, and has also been reported to the law officers of the Government. The members of the Northeast Washington Citizens' Association have lately made a renewed effort to have this reservation restored to the United States and improved for the beautifying of that part of the city.

Reservation No. 125, by the Central Union Mission, as a place of worship.

Reservation No. 186, by the Bethany Chapel of the New York avenue Presbyterian congregation.

Reservation No. 293, intersection of Canal and N streets S. and First street W., occupied by a party who built a frame house thereon in 1888. This case has been in the hands of the United States district attorney for the District of Columbia for the past six years.

Reservation No. 249 is occupied as a lumber yard, by a party who claims to rent it from a gentleman in Port Deposit, Md.

Reservations Nos. 137, 138, 141, 152, 164, and 169 have been inclosed with iron or wire fences and partially improved by the owners of adjacent property.

The following also are improved and utilized by adjacent property owners: Nos. 65, 67, 139, 143, 161, 162, 167, 168, 175, 208, and 284.

STATUES.

There are 17 statues in the national public grounds under charge of this office, as follows:

Daguerre, Admiral Du Pont, Admiral Farragut, President Garfield, General Greene, Dr. Gross, General Hancock, Professor Henry, President Jackson, Lafayette, President Lincoln (2), General McPherson, General Rawlins, General Scott, General Thomas, Washington.

The stains on the bronze work of all the statues in the parks and the worst stains on their stone pedestals were cleaned off, and broken joints in the stonework of those pedestals were repaired with Portland cement.

All of these statues are in good condition, but there should be a small annual appropriation of $150 for cleaning them and pointing up the pedestals.

The statue of Prof. Samuel D. Gross, M. D., LL. D., was placed by the sculptor upon the pedestal constructed by the United States in the Smithsonian grounds, and was unveiled with appropriate ceremonies May 6, 1897. The figures "1897" were cut under the inscription on the pedestal of this statue and bronzed and the incised letters of the inscription were rebronzed.

The statue of Daguerre was removed from the National Museum, where its room was needed and where it could hardly be seen to advantage, to a good site east of the Museum.

The foundation for the statue of General Logan has been built in Iowa Circle, the fountain having been removed, and it is expected that the bronze pedestal will arrive and be in position before the end of the calendar year 1897.

It is anticipated that within the next three years statues will be erected in the parks in the city of Washington to the memory of Generals Sherman, Sheridan, and Logan.

MONUMENT AND WHARF AT WAKEFIELD, VA., THE BIRTHPLACE OF WASHINGTON.

The lawn around the monument has been mown as required during the year by the United States watchman in charge.

The iron railing around the monument being in need of repainting, the Comptroller of the Treasury was asked, in April, 1897, whether a portion of the small balance remaining from the appropriation for the construction of the monument could be applied to its maintenance. He replied that the balance was not applicable to that purpose.

The iron-pile wharf at Bridge Creek Landing, near Wakefield, erected under the supervision of this office in 1894 under the direction of the Department of State, was damaged in February, 1897, by a violent storm and extensive ice jam, and 11 of the iron piles broken. The facts were at once reported to the Chief of Engineers, and an estimate for funds for its repair, amounting to $987, submitted. No appropriation having been made, the repairs have not been undertaken by the United States, but in March, 1897, a permit was granted by the Secretary of War to a gentleman living in the vicinity to make temporary repairs to the wharf by propping up broken parts with wooden posts so that he could put timber off from it. In granting the permit, it was provided that no compensation should be paid by the United States for the work and that it should not hereafter constitute a claim against the United States.

LEGISLATION NEEDED.

Experience of years has shown the urgent need of better-defined regulations than now exist for the protection of the national park grounds in the District of Columbia and for the better security and comfort of the public.

A draft of suitable legislation to obtain this was prepared by my predecessor (Gen. John M. Wilson, Chief of Engineers) and printed as House Doc. No. 81, Fifty-fourth Congress, first session. It is as follows:

AN ACT to regulate the use of the public parks and improved reservations under charge of the Chief of Engineers, United States Army, within the limits of the District of Columbia.

Whereas the improved parks and reservations under the charge of the Chief of Engineers, United States Army, within the limits of the District of Columbia, are for the purpose of adorning the District; therefore, the following statute for the regulation of the public use of such parks and reservations is hereby enacted:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That public travel in and occupancy of the improved parks and reservations within the limits of the District of Columbia, under the charge of the Chief of Engineers, shall be restricted to the roads, walks, and places prepared for the purpose by flagging, paving, or otherwise.

SEC. 2. That it is forbidden to occupy the roads in such manner as to hinder or obstruct their proper use, to drive rapidly upon them or with animals not under perfect control, or to use them for the conveyance of goods or merchandise, except to or from the public buildings erected upon them on Government service.

SEC. 3. That it is forbidden to expose any article for sale; to throw stones or missiles; to interfere with birds; to display any sign, placard, or form of advertisement; to solicit fares, alms, subscriptions, contributions; to discharge firearms, fireworks, or explosives, or set fire to any combustible: *Provided, however,* That upon public holidays or other occasions of rejoicing, the officer in charge of public buildings and grounds, or such subordinate officer as he may direct, may permit, at his discretion, the use of such grounds in the vicinity of the Washington Monument as he may deem best, for the purpose of fireworks display and firing salutes.

SEC. 4. That it is forbidden to make any harangue, or utter loud, threatening, abusive, or profane language, to play games of chance, to bathe or fish in fountain basins, or to do any obscene or indecent act, or to commit a nuisance of any character.

SEC. 5. That it is forbidden to step or climb upon, remove, or in any way injure any monument, statue, fountain, wall, fence, or other construction, or any tree, shrub, plant, turf, or flower, or to interfere in any way with the waterworks.

SEC. 6. That it is forbidden to ride or drive a horse at a rate faster than eight miles an hour; to ride a cycle at a rate faster than eight miles an hour, or without a bell attached or a light at night.

SEC. 7. That it is forbidden to play ball or other games or sports, except upon grounds specially provided for that purpose.

SEC. 8. That offenses against this act shall be triable before the police court of the District of Columbia, and shall be punishable by fine or imprisonment, or both, at the discretion of the judge of such court, the fine not to exceed one hundred dollars; the imprisonment not to exceed sixty days. But in case of heinous offenses, by reason of which public property shall have suffered damage to an amount exceeding one hundred dollars in value, said judge of the police court may commit or hold to bail the offender for trial before the supreme court of the District of Columbia, when the offense shall be punishable by imprisonment in the penitentiary for a period of not less than six months nor more than five years.

SEC. 9. That it shall be the duty of all policemen and watchmen having authority to make arrests in the District of Columbia to be watchful for offenses against this act, and to arrest and bring before the proper tribunal those who shall offend against it under their observation, or of whose offenses they shall be advised by witnesses.

SEC. 10. That it shall be the duty of all persons employed in the service of the Government, under the officer in charge of public buildings and grounds, to prevent, as far as may be in his power, offenses against this act, and to aid the police by information or otherwise in securing the arrest and conviction of offenders.

A similar law applying to the Capitol grounds has been in existence since 1882, and corresponding legislation is urgently needed and respectfully urged for the proper administration of the public interests in charge of this office.

Estimates for the fiscal year ending June 30, 1899.

Salaries of employees, public buildings and grounds, etc.:	
One office clerk	$1,600.00
One messenger	840.00
One public gardener	2,500.00
One clerk in charge of old public records of Washington City	1,500.00

Salaries of employees, etc.—Continued.		
One electrician and telegraph lineman	$1,080.00	
Overseers, draftsmen, copyist, foreman, gardeners, mechanics, and laborers	35,000.00	
One day watchman in Lafayette Park	660.00	
One day watchman in Franklin Park	660.00	
Two day watchmen in Smithsonian grounds, at $660 each	1,320.00	
Two night watchmen in Smithsonian grounds, at $720 each	1,440.00	
One day watchman in Judiciary Park	660.00	
One night watchman in Judiciary Park	720.00	
One day watchman at Lincoln Park and adjacent reservations	660.00	
One day watchman at Iowa Circle	660.00	
One day watchman at Thomas Circle and neighboring reservations	660.00	
One day watchman at Washington Circle and neighboring reservations	660.00	
One day watchman at Dupont Circle and neighboring reservations	660.00	
One day watchman at McPherson and Farragnt parks	660.00	
One day watchman at Stanton Park and neighboring reservations	660.00	
Two day watchmen at Henry (Armory) and Seaton parks, at $660 each	1,320.00	
One night watchman at Henry (Armory) and Seaton parks	720.00	
One day watchman at Mount Vernon Park and adjacent reservations	660.00	
One day watchman at grounds south of Executive Mansion	660.00	
One watchman for greenhouses and nursery	660.00	
One day watchman at Garfield Park	660.00	
One night watchman at Garfield Park	720.00	
One watchman for the care of the monument and dock at Wakefield, Va., the birthplace of Washington	300.00	
		$58,300.00
Contingent expenses, public buildings and grounds		500.00
Improvement and care of public grounds:		
Improvement and maintenance of grounds north and south of Executive Mansion	5,000.00	
Ordinary care of greenhouses and nursery	2,000.00	
Ordinary care of Lafayette Park	1,000.00	
Ordinary care of Franklin Park	1,000.00	
Improvement and ordinary care of Lincoln Park	2,000.00	
Care and improvement of Monument grounds	6,000.00	
Continuing improvement of Reservation No. 17, and site of old canal northwest of same	3,000.00	
Construction and repair of iron fences, and constructing stone coping about reservations	1,500.00	
Manure, and hauling same	5,000.00	
Painting watchmen's lodges, iron fences, vases, lamps, and lamp-posts	1,500.00	
Purchase and repair of seats	1,000.00	
Purchase and repair of tools	2,000.00	
Trees, tree and plant stakes, labels, lime, whitewashing, and stock for nursery	3,000.00	
Removing snow and ice	1,500.00	
Flowerpots, twine, baskets, wire, splints, moss, and lycopodium	1,000.00	
Care, construction, and repairs of fountains	1,500.00	
Abating nuisances	500.00	
Improvement, care, and maintenance of various reservations	20,000.00	
Improvement, maintenance, and care of Smithsonian grounds, etc	8,000.00	
Improvement, care, and maintenance of Judiciary Park	8,000.00	
Granite curbing around Franklin Park	5,000.00	
Asphalt walk around the ellipse south of Executive Mansion	10,500.00	
Granite curbing around Lincoln Park	6,000.00	
Laying asphalt walks in various reservations	2,000.00	
Improvement and care of Henry and Seaton parks	3,000.00	
Improvement of Howard University Park	5,000.00	
For lodges for park watchmen at Stanton, Thomas, and McPherson parks, at $500 each	1,500.00	

Improvement and care of public grounds—Continued.		
Cleaning statues and repairing pedestals	$150.00	
For improvement of Reservation No. 140, corner of New Hampshire avenue and M street	2,000.00	
For improvement of Reservation No. 19, near navy-yard	5,000.00	
		$114,650.00
Care, repairs, fuel, etc., Executive Mansion:		
For care, repair, and refurnishing Executive Mansion, to be expended by contract or otherwise, as the President may determine	30,000.00	
For portrait and frame for same of Hon. Grover Cleveland, ex-President of the United States	2,500.00	
Fuel for Executive Mansion, greenhouses, and stable	3,000.00	
Care and necessary repair of greenhouses	5,000.00	
Repairs to conservatory	2,000.00	
		42,500.00
Lighting the Executive Mansion and the public grounds:		
Gas, pay of lamplighters, gas fitters, and laborers; purchase, erection, and repair of lamps and lamp-posts; purchase of matches and repairs of all kinds, fuel and lights for office and office stable, for watchmen's lodges, and for greenhouses at the nursery: *Provided*, That for each 6-foot burner not connected with a meter in the lamps on the public grounds not more than $20 shall be paid per lamp for gas, including lighting, cleaning, and keeping the lamps in repair, under any expenditure provided for in this act, and said lamps shall burn every night on the average from forty-five minutes after sunset to forty-five minutes before sunrise; and authority is hereby given to substitute other illuminating material for the same or less price, and to use so much of the sum hereby appropriated as may be necessary for that purpose	13,000.00	
For lighting 7 arc electric lights in grounds south of the Executive Mansion three hundred and sixty-five nights, at 20 cents per light per night	511.00	
For lighting 32 arc electric lights in Lafayette, Franklin, Judiciary, and Lincoln parks three hundred and sixty-five nights, at 25 cents per light per night	2,920.00	
For lighting 20 arc electric lights in Executive Mansion grounds and Monument Park, conduits, underground wires, poles, etc., to be furnished by the electric-light company, three hundred and sixty-five nights, at 30 cents per light per night	2,190.00	
		18,621.00
Repairs to water pipes and fire plugs:		
Repairing and extending water pipes, purchase of apparatus for cleaning them, purchase of hose, and for cleaning the springs and repairing and renewing the pipes of the same that supply the Capitol, the Executive Mansion, and the building for the State, War, and Navy Departments		2,500.00
Telegraph to connect the Capitol with the Departments and the Government Printing Office:		
For care and repair of existing lines		1,500.00
Total		238,571.00

Washington Monument, elevator, electric lights, and machinery connected therewith.

The following estimate for operating the elevator, the electric lights, and the machinery connected therewith for the fiscal year ending June 30, 1899, is submitted:

1 custodian, at $100 per month	$1,200.00
1 steam engineer, at $90 per month	1,080.00
1 assistant steam engineer, at $70 per month	840.00
1 fireman, at $60 per month	720.00
1 assistant fireman, at $60 per month	720.00
1 conductor of elevator car, at $75 per month	900.00

1 attendant on floor, at $60 per month	$720.00
1 attendant on top floor, at $60 per month	720.00
3 night and day watchmen, at $60 per month	2,160.00
For fuel, lights, oil, waste, packing, tools, matches, paints, brushes, brooms, lanterns, rope, nails, screws, lead, electric lights, heating apparatus, oil stoves for elevator car and upper and lower floors, repairs to engines, boilers, dynamos, elevator, and repairs of all kinds connected with the Monument and machinery, and purchase of all necessary articles for keeping the Monument, machinery, elevator, and electric-light plant in good order	3,000.00
Total	12,060.00

As some of the foregoing estimates are larger than the amounts heretofore appropriated, and as others are for new work, it is deemed advisable to submit the following brief explanation in reference thereto:

First. One public gardener, $2,500. I have asked for an increase in the salary of the public gardener, a position now so satisfactorily filled by Mr. George H. Brown. The duties of the office require that the gentleman who fills it shall be thoroughly skilled in the culture of trees, shrubs, and plants, and shall have a practical knowledge of civil engineering as applied to landscape gardening. Mr. Brown combines these attributes, to which he adds taste, industry, and integrity. His duties take him from one end of the city to the other. He is directly responsible for the care of the valuable collection of plants in the propagating gardens, and superintends the propagation of plants that are annually raised for the public grounds, which this year numbered about 500,000.

Second. One clerk in charge of old public records of Washington City, $1,500. These records include maps, deeds, records, books, letters, etc., from the organization of the original Board of Commissioners, near the close of the last century, up to 1867, when the duties were turned over to the Chief of Engineers. They are constantly examined by attorneys and others interested in lands in Washington, and the person in charge of them is frequently required to produce them in court. To index them properly, to be able to turn at once to the details of any question raised, requires familiarity with every paper. This work has for the last few years been intrusted to the only draftsman allowed this office, and during the past year at least one-fourth of his time has been actually employed on this duty. It is desirable that this appropriation be made in order that the draftsman may be permitted to attend to the necessary and legitimate duties of his office.

Third. For one telegraph lineman, $1,080. The telegraph system under charge of this office includes about 8 miles of overhead wire. There are eighteen offices connected with these lines, the main battery being at this office. The lineman is constantly engaged in the care of the main and local batteries and such necessary repairs and extensions as a system of wires of this kind requires. He is industrious, efficient, and capable, and has won the confidence of all with whom he has come in contact by faithful attention to his duties.

Fourth. An increase in the appropriation for overseers, foremen, etc., is urgently requested. As the city of Washington is spreading to the north, east, and west, the area of improved reservations must be increased to keep pace with private enterprise, and the small increase requested will be of the utmost advantage in continuing the ornamentation of spaces now entirely unimproved.

Fifth. For the care and improvement of the Monument Grounds, $6,000. It is desirable that this important improvement should progress more rapidly than heretofore. The amount ($3,000) appropriated for 1897 was sufficient merely to maintain the park in its present condition, and hardly admitted any improvements in the unfinished portions of the grounds.

Sixth. For manure and hauling the same, $5,000 is asked, instead of $4,000. The increase is requested in order that the additional quantity of this material required for the park lawns may be purchased.

Seventh. For painting watchmen's lodges, iron fences, vases, lamps, and lamp-posts, $1,500 is requested. There are 11 watchmen's lodges, a number of post-and-chain fences, 21 vases, over 400 lamp-posts, and the iron fence around the Executive Mansion, all of which should be painted in 1898–99.

Eighth. For trees, tree and plant stakes, etc., and stock for nursery, $3,000 is asked, in place of $2,000, last granted. The larger sum is the amount appropriated annually for more than twelve years ending June 30, 1892.

Ninth. For removing snow and ice, the sum of $1,500 is asked. The sum usually granted, viz, $1,200, is generally sufficient, but sometimes is not.

Tenth. Twenty thousand dollars is asked for improvement, care, and maintenance of various reservations, in place of the $10,000 granted this year. It is proposed to improve as many as possible of the unimproved reservations. Each year from one to three are added to the list of improved reservations, and if the funds now requested become available six or eight can be added during the fiscal year ending June 30, 1899. As reservations are thus improved the expense of the care of the whole is slightly increased, for the improvements must be maintained.

Eleventh. For the Smithsonian Grounds $8,000 is asked, and for Judiciary Park $8,000, in place of $2,500, granted last year. The increased amounts can be profitably expended during the fiscal year ending June 30, 1899, in the improvement of those parks.

Twelfth. Five thousand dollars is asked for a granite curbing around Franklin Park, and $6,000 for a curbing of same style around Lincoln Park. The beauty of these handsome parks will be greatly enhanced by placing around them granite curbings similar to those used around the parks of the same character in the larger cities elsewhere.

Thirteenth. An estimate of $10,500 is submitted for an asphalt walk around the ellipse south of the Executive Mansion for reasons given in this report.

Fourteenth. For improvement, care, and maintenance of Henry (Armory) and Seaton parks, $3,000. These reservations, extending from Seventh street to the Botanic Gardens, cover an area of 34 acres, with road and walk surfaces of over 10,000 square yards. They are in an advanced state of improvement. Their beauty has been marred by the depot and tracks of the Baltimore and Potomac Railroad. A mound has been constructed around the depot, upon which it is intended to plant trees and shrubs, so that in time the depot will be hidden from view. The materials for this mound have been obtained free of expense to the United States, and now it is proposed to plant it. The funds requested are needed for this purpose and for the care of roads, lawns, gutters, etc., and laying out additional paths.

Fifteenth. Estimates are submitted for the improvement of Howard University Park, for Reservation No. 140, at the intersection of New Hampshire avenue and M street, and for Reservation No. 19, near the navy-yard. The necessity for all these improvements is fully set forth in the preceding pages of this report.

Sixteenth. For lodges for park watchmen in Stanton, Thomas, and McPherson reservations, at $500 each, $1,500. The watchmen in these reservations are exposed to the inclemency of the weather at all seasons of the year. Rain or shine, hot or cold, night or day, year in and year out they must be at their stations, and take shelter, when necessary, either under a tree or in such a dwelling or store as will offer its hospitality. The dictates of humanity call for this appropriation.

Seventeenth. For care, repair, and refurnishing of Executive Mansion, etc., $30,000. Ten thousand dollars has to be set aside at the beginning of each fiscal year for care and maintenance of the Mansion, including salaries of employees of all kinds. This has left in past years practically but $10,000 for refurnishing and repairs of all kinds. The Executive Mansion is not at all luxuriously furnished, and in fact lacks many of the comforts of a modern home, and economy has been so strictly observed for the past few years that new and extensive repairs are now absolutely needed. The present plumbing system is not in excellence beyond what in these days would be expected in a $12,000 house and should be renewed throughout. This work consists of two parts—first, the building of a proper accessible conduit for all underground pipes and wires and the placing of them in the conduit; second, the renewal and installation of all plumbing apparatus above ground in a systematic, safe, and modern way. Each of the above parts of this work will cost not less than $5,000 if properly done.

Eighteenth. The sum of $150 is asked for repairing pedestals and cleaning statues. Several of the pedestals need repointing, and the statues are from time to time disfigured by birdlime, which must be removed.

Nineteenth. The appropriation requested for lighting the Executive Mansion and public grounds, and which is in excess of that made last year, is deemed very necessary in order to change the system in the Executive Mansion Grounds and Monument Park from gas to electric lights. Should this use of electricity in the grounds mentioned be authorized, the expense for gas would be reduced about $600 per annum. There are no lights in the Monument Grounds.

Twentieth. I recommend that the salaries of the two steam engineers at the Washington Monument be increased from $80 and $60 to $90 and $70 per month, respectively. The duties of these two men are of great importance. Upon their efficiency and intelligence depend, to a great extent, the lives of those who use the elevator. The increase asked is small and the men deserve it. I also recommend that the pay of the two firemen be placed at $60 per month each. That is the rate allowed firemen in the Executive Departments, and there appears to be no reason why the firemen at the Monument should receive less.

In submitting these estimates, I earnestly recommend that the various items under the heading of "Improvement and care of public grounds" be aggregated under one head, and while each item of work shall be named, the whole shall be covered by a general sum, not a specific sum for each item. This is done in other departments of the Government, particularly the Quartermaster's Department of the Army. It saves quite an amount of clerical labor by permitting the preparation of accounts under one heading, rather than under about thirty. Moreover, it permits small balances which might be saved from one item to be used in some other equally necessary and important work.

This recommendation is based strictly upon business principles and is for the purpose of reducing clerical labor and expediting the progress of the work.

Financial statement for fiscal year ending June 30, 1897.

Title of appropriation.	Year.	Available at beginning of fiscal year.	Expended during fiscal year.	Pledged by contracts.	Unexpended balance to revert to Treasury.
Improvement and care of public grounds	1897	$52, 800. 00	$52, 228. 85		$571. 15
Repairs, fuel, etc., Executive Mansion	1897	29, 000. 00	26, 643. 01	$1, 748. 99	606. 41
Lighting, etc., Executive Mansion, etc	1897	17, 781. 40	15, 001. 95		2, 779. 45
Repairs to water pipes and fire plugs	1897	2, 500. 00	2, 474. 67		25. 33
Telegraph to connect Capitol with the Departments and Government Printing Office.	1897	3, 100. 00	3, 099. 92		. 08
Contingent expenses, public buildings and grounds	1897	500. 00	498. 75		1. 25
Salaries of employees, public buildings and grounds	1897	48, 020. 00	47, 825. 35		194. 65
Care and maintenance of the Washington Monument	1897	11, 520. 00	11, 292. 18		227. 82
Branch printing office, War Department	1897	5, 649. 25	5, 490. 15		159. 10
Pedestal for statue of Gen. John A. Logan		48, 000. 00		48, 000. 00	
Statue of Gen. Wm. T. Sherman		80, 000. 00		80, 000. 00	
Building for Government Printing Office repairs, and rent *a*		28, 445. 68	42. 15		
Building for Government Printing Office (act March 2, 1895) *a*		446. 51	437. 23		
Purchase and repair of building where Abraham Lincoln died *a*		31, 000. 00	30, 173. 00		
Pedestal for statue of Dr. Saml. D. Gross *a*		37. 41	4. 25		
Lincoln tablet, Gettysburg National Park *a*		4, 934. 60			

a Not fiscal year appropriations.

A special appeal is made to the liberality of Congress for the following urgently needed funds in excess of last year's appropriations:

For the employment of a clerk for the care of the old records of the city of Washington, as explained under the heading of "Old records"	$1,500
Increase in the salary of the public gardener to $2,500, for reasons given above, and because it is more nearly what is paid for such services elsewhere throughout the United States	700
For the item "Salaries of overseers, foremen, gardeners, laborers," etc	7,000

Our funds are now so limited, that in May and June, when men are most needed for the care of the parks (that being the most favorable season), we have to begin discharging, and in this way lose men trained in our work and have to train green hands later, which is not economical, but expensive.

In conclusion, I desire to express my sincere appreciation of the faithful and efficient manner in which Mr. George H. Brown, the skillful and accomplished public gardener, and Mr. E. F. Concklin, overseer and chief clerk, have performed the various and important duties committed to their charge.

I am, General, very respectfully, your obedient servant,

THEO. A. BINGHAM,
Colonel, U. S. Army, Captain Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

APPENDIX C C C.

NORTHERN AND NORTHWESTERN LAKES—SURVEYS—CORRECTING ENGRAVED PLATES—PRINTING AND ISSUING OF CHARTS.

REPORT OF LIEUT. COL. G. J. LYDECKER, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 23, 1897.

GENERAL: I have the honor to submit herewith my annual report, in duplicate, on the "Issue of the published charts of the Northern and Northwestern Lakes, and surveys made for the purpose of keeping these charts up to date," for the fiscal year ending June 30, 1897.

Very respectfully, your obedient servant,

G. J. LYDECKER,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

C C C I.

NORTHERN AND NORTHWESTERN LAKES—SURVEYS—CORRECTING ENGRAVED PLATES—PRINTING AND ISSUING OF CHARTS.

The sundry civil acts of August 18, 1894, March 2, 1895, June 11, 1896, and June 4, 1897, have each contained appropriations as follows:

> *Survey of Northern and Northwestern Lakes.*—For printing and issuing of charts for use of navigators and electrotyping plates for chart printing, two thousand dollars.
>
> For surveys, additions to, and correcting engraved plates, to be available until expended, twenty-five thousand dollars.

Under the first item the issuing of charts has been done from the United States Engineer Office, at Detroit, Mich., the rest of the work required by that item being attended to in the office of the Chief of Engineers, in Washington, D. C. During the fiscal year ending June

30, 1897, charts were received and disposed of at the Detroit office as follows:

Description.	Number.	Total.
On hand July 1, 1896	4,193	
Received during the year	4,597	
Total on hand and received		8,750
Sold at 31 cents each	4	
Sold at 30¾ cents each	6	
Sold at 27 cents each	101	
Sold at 26¾ cents each	245	
Sold at 25 cents each	28	
Sold at 20 cents each	3,403	
Sold at 10 cents each	27	
Sold at 7 cents each	14	
Sold at 6¼ cents each	8	
Issued to United States vessels and for official use	319	
Destroyed, worthless, not showing corrections to date	743	
Total disposed of		4,897
On hand July 1, 1897		3,853

The sum of $787.30 was turned into the United States Treasury from sales of charts. The total number of charts disposed of to June 30, 1897, has been 214,512.

Operations during the fiscal year under the second item of the act have been as follows:

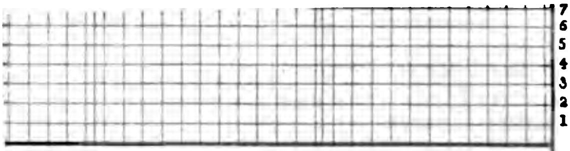
Corrections and additions were made in the Detroit office on charts named below, and these charts were then forwarded to the office of the Chief of Engineers, where the engraved plates were correspondingly amended, as follows:

Portage Lake and River.
Straits of Mackinac.
Beaver Group.
Lake Michigan, north end.
Lake Michigan, south end.
River Ste. Marie, No. 1.
River Ste. Marie, No. 2.
Coast Chart No. 6, Lake Michigan.
Coast Chart No. 9, Lake Michigan.
Detroit River.
Lake Huron.
Saginaw Bay, Lake Huron.
Lake Erie.
Coast Chart No. 1, Lake Erie.
Coast Chart No. 2, Lake Erie.
Coast Chart No. 3, Lake Erie.
Coast Chart No. 4, Lake Erie.
Coast Chart No. 5, Lake Erie.
Coast Chart No. 6, Lake Erie.
Coast Chart No. 7, Lake Erie.

These corrections have been based, to a very large extent, on information obtained from engineer officers in charge of lake harbor improvements and other reliable official sources.

RESURVEY OF ST. MARYS RIVER.

Conforming to a general plan for meeting the demand for new and perfected charts, a resurvey of the St. Marys River was commenced in 1892, and has been continued since then whenever funds were available. The field work needed for this purpose was completed during the last fiscal year, except some magnetic observations, which will be made in the near future. The field work included the completion of triangulation between Lake Superior and Straits of Mackinac, remeasurement of the Mackinac base line, topography and hydrography from St. Joseph Island to mouth of the river, precise levels from mouth of Charlotte River to Detour, and a few magnetic observations. In office work, chart No. 3 was completed, except those features that depend on further



ATER LEVEL CURVE,

E SUPERIOR

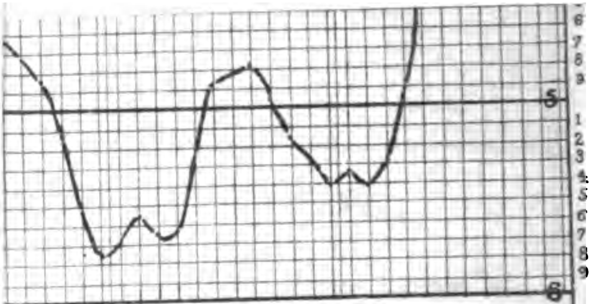
ations taken "above the Locks" at

Falls Canal, Mich.

e shows the elevation of the surface
tide at New York. The mean eleva-
platted. The datum plane is
'(mean tide at New York.).

annual Report for the fiscal year

G. J. Lydecker
Lieut. Col. Corps of Engrs.



ATER LEVEL CURVE AT
ACH, LAKE HURON

onthly means of Noon readings.

the Sand Beach Curve was fixed by means aken at Sand Beach and Port Austin dur. l August 1882, from which Port Austin zero tum was found to be 108.36 ft. above Sand

ference is 6.19 ft below this zero. l be 102.17 ft below Lake Survey plane of w U.S. Bench Mark on the shore near west 17 ft. above mean tide at New York as giv-

r annual Report for the Fiscal year ending

Lieut. Col. Corps of Engrs.

Eng 55 2

magnetic observations; chart No. 2 is about half done, and the projection of chart No. 1 was commenced; current measurements made during the preceding year were resumed, and the average rainfall in the upper lake basins from 1886 to 1896 was computed from available data, principally that obtained from the United States Weather Bureau.

In addition to the St. Marys River charts, a new chart of Lake Michigan in one sheet (scale 1:400000) was commenced in March, and by the end of the year it was about one-third completed.

The following table shows the monthly means of water levels, as derived from daily observations of gauges at Sand Beach, Mich., on Lake Huron, and at the head of the St. Marys Falls Canal, Sault Ste. Marie, Mich.:

Monthly means of water levels for Sand Beach and Sault Ste. Marie, expressed in feet, below the planes of reference adopted in 1876.

Station.	1896.						1897.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
Sand Beach	4.81	4.77	4.95	5.15	5.29	5.41	5.33	5.42	5.28	4.94	4.37	4.15
Sault Ste. Marie	2.23	2.21	2.35	2.77	2.76	2.81	3.04	3.35	3.33	3.19	2.85	2.49

Hydrographs of monthly means of water levels for Lakes Huron and Superior from January, 1894, to July, 1897, accompany this report.

Reports by Assistant Engineers E. E. Haskell, Thos. Russell, and H. von Schon, are also submitted, as giving the details of operations, and containing valuable data for future reference.

The work of amending existing lake-survey charts, and of projecting new ones, is of the highest importance to navigation of the Great Lakes; but it is impossible to do this with credit to the service or satisfaction to the navigator unless the necessary data be supplied by complete systematic surveys. The work should not be postponed, but pressed forward with dispatch, and an annual appropriation of $50,000 for a few years is essential for anything like reasonable, satisfactory, or economical progress, and such appropriation must be regarded as a small one considering the vast commercial interests at stake.

The estimate submitted for the fiscal year ending June 30, 1899, is therefore as follows:

For surveys and all expenses connected with correcting and extending charts of the Northern and Northwestern Lakes, to be available until expended	$50,000

Money statement.

July 1, 1896, balance unexpended	$22,829.09
Amount allotted from act of June 11, 1896	1,500.00
Amount allotted from act of June 4, 1897	20,700.00
	45,029.09
June 30, 1897, amount expended during fiscal year	18,431.83
July 1, 1897, balance unexpended	26,597.26
July 1, 1897, outstanding liabilities	875.50
July 1, 1897, balance available	25,721.76

Dates and amounts of appropriations for survey of northern and northwestern lakes.

March 3, 1841	$15,000
May 18, 1842	20,000
March 1, 1843	30,000
June 17, 1844	20,000
March 3, 1845	20,000
August 8, 1846	25,000
August 12, 1848	25,000
March 3, 1849	10,000
September 28, 1850	25,000
March 3, 1851	25,000
August 30, 1852	25,000
March 3, 1853	50,000
August 5, 1854	50,000
March 3, 1855	50,000
August 30, 1856	50,000
March 3, 1857	50,000
June 12, 1858	75,000
March 3, 1859	75,000
June 21, 1860	75,000
March 2, 1861	75,000
July 5, 1862	105,000
February 9, 1863	106,879
July 2, 1864	100,000
February 28, 1865	125,000
June 12, 1866	50,000
March 2, 1867	77,500
March 2, 1868	$77,500
July 20, 1868	75,000
March 3, 1869	100,000
July 15, 1870	100,000
March 3, 1871	175,000
June 10, 1872	175,000
March 3, 1873	175,000
June 23, 1874	175,000
March 3, 1875	150,000
July 31, 1876 (not including $16,000 applied to survey of Mississippi River)	84,000
March 3, 1877 (not including $25,000 applied to survey of Mississippi River and including $9,500 received from sale of steamers)	94,500
June 20, 1878 (not including $49,500 applied to survey of Mississippi River)	49,500
March 3, 1879	85,000
June 16, 1880	40,000
March 3, 1881	18,000
August 7, 1882	12,000
Total	2,939,879

PRINTING AND ISSUE OF CHARTS FOR USE OF NAVIGATORS, AND ELECTROTYPING COPPERPLATES FOR CHART PRINTING.

March 3, 1883	$3,000
July 7, 1884	3,000
March 3, 1885	3,000
August 4, 1886	2,000
March 3, 1887	2,000
October 2, 1888	2,000
March 2, 1889	2,000
August 30, 1890	2,000
March 3, 1891	2,000
August 5, 1892	$2,000
March 3, 1893	2,000
August 18, 1894	2,000
March 2, 1895	2,000
June 11, 1896	2,000
June 4, 1897	2,000
Total	33,000

SURVEYS AND ADDITIONS TO AND CORRECTING ENGRAVED PLATES.

March 2, 1889	$5,000
August 30, 1890	10,000
March 3, 1891	10,000
August 5, 1892	5,000
March 3, 1893	25,000
August 18, 1894	25,000
March 2, 1895	$25,000
June 11, 1896	25,000
June 4, 1897	25,000
Total	155,000

List of contracts in force during the fiscal year ending June 30, 1897.

Name of contractor.	Contract approved.	Remarks.
Newton & MacBean	Aug. 19, 1896	For fiscal year ending June 30, 1897.
P. E. Gallagher	do	
P. C. Keliher	do	
Prenzlauer Bros	do	
Wm. Ogle	do	
D. C. Keliher	do	
J. B. Sweatt	do	
P. M. Church & Co	do	
The Richmond & Backus Co	do	
Frank Perry	Aug. 21, 1896	
Wm. Ogle	Aug. 26, 1896	

A.—REPORT OF MR. E. E. HASKELL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1897.

SIR: I have the honor to submit the following report upon work pertaining to the survey of the northern and northwestern lakes, resurvey of St. Marys River, that has been intrusted to me during the fiscal year ending June 30, 1897:

This work has been the field and office work of the primary triangulation, the astronomical work pertaining thereto, the magnetic observations made during the year, the measurement of the Mackinaw base line, the construction of a comparator for testing the length of tapes and the fitting up of a comparing room in connection with it, and the supervision of the topographical drawing since the granting of the indefinite leave of absence to Asst. Engineer H. von Schon, on March 15, 1897.

PROGRESS OF THE FIELD AND OFFICE WORK OF THE TRIANGULATION.

Attention is invited to my last annual report, beginning on page 4023, part 6, of the Report of the Chief of Engineers for 1896, for a statement showing the condition of the primary triangulation at the close of the last fiscal year. At that time the triangulation originally planned in connection with the resurvey of St. Marys River had been completed, with the exception of the chain forming what has been called the Mackinaw connection. During the past year this unfinished work has been completed. To give a clear idea of it we have prepared a map (Pl. I), on which is given the whole system of the primary triangulation of the resurvey of St. Marys River as completed. That part of the work finished during the past year began with the line Iroquois-Duke and ended with the Mackinaw base line. Of this chain of triangles, Stations Maple Hill, Robinson, and Mackinac Island had been built during the previous fiscal year. The remainder, five in number, were built by the angle-reading parties during the fiscal year 1897.

These stations were all small, the highest one being but 15 feet.

The nine stations, beginning with Duke and Maple Hill and ending with the two base stations, were occupied and the angles at each station read, thus completing the triangulation proper.

There were two angle-reading parties engaged upon this work, one in charge of Asst. Engineer Thomas Russell and the other in charge of the writer. Mr. Russell took the field July 7, and returned to the office November 16, after having occupied Stations Duke, Maple Hill, Robinson, Goose Island, St. Ignace, and Rabbits Back. The writer took the field August 10, and after completing the measurement of the Mackinaw base line on October 27, occupied Stations West Base, East Base, and Mackinac Island.

Stations East Base, West Base, St Ignace, Mackinac Island, and Rabbits Back are ones belonging to the old triangulation of the Straits of Mackinac that extended from Spectacle Reef to High Island, work that was executed between 1849 and 1855, by Capt. J. N. Macomb. A description of these stations is given in Professional Papers No. 24, from which we found them. Although the marks left to indicate their geodetic points were in a fair state of preservation, they were all renewed and will be described for future reference.

A (West Base), 1851, 1852, 1853, 1896.—This station marks the northwest end of the Mackinaw base line and was found from the description on page 787 of Professional Papers No. 24. It is directly in front of the light-house at McGulpins Point, Straits of Mackinac. "The geodetic point was marked by the intersection of two lines at the center of a square cut in the upper surface of a limestone block, the figure 7 being cut in one of the small squares." This limestone block is a post about 30 inches long by 6 inches square, having a dressed top. We drilled a hole about 4 inches deep at the old center, and cemented into the post with Portland cement a three-eighths by 4 inch brass rod, on the end of which was cut a +. This post was reset for the surface mark, the top of it being about 8 inches under ground. Underneath this, for a more permanent mark, was sunk a sugar barrel with its top end 4 feet below the surface of the ground. This barrel was filled with concrete, in the top of which was set a brass plug about 5 inches long, 1¼ inches in diameter at its top end and 2 inches in diameter at its base, having a hole about one-eighth of an inch in diameter to mark its center. The plug was fitted with a cap of the same material, to protect the mark from injury. Great care was used in setting both of these marks to restore absolutely the position of the geodetic point as we found it. To find the station, strike a circle having a radius of 23.6 from the northeast corner of the light-house dwelling as a center; from the front angle of the tower of the light-house strike a circle with a radius of 13.1 feet, and underneath the point where this circle cuts the first one will be found the geodetic point.

B (East Base), 1852, 1853, 1896.—This station marks the southeast end of the Mackinaw base line. "The geodetic point was marked by a fine line on a silver 10-cent piece set in the top of a limestone post 4½ feet long, dressed at its upper end."

This station stands nearly in the middle of the highway leading from Mackinaw City to Cheboygan, and about 2½ miles east of Mackinaw City, as indicated by the mile-posts of the Michigan Central Railway, along which the highway runs. We could not find any of the old reference stones described in Professional Papers No. 24. For future use we set a reference stone about 5 by 7 by 18 inches, marked U + S on top, directly underneath the railroad fence and on a line to Round Island light-house. It is 32.7 feet north of East Base.

The geodetic point was marked by a barrel of concrete, in the top end of which was set a brass plug like the one used to mark West Base. This mark is 3.6 feet below the surface of the ground. For the surface mark the silver 10-cent piece, which was loose in the post, was replaced by a ⅜ by 4 inch brass rod, in the end of which was cut a + for the center. The post was then cut off to 26 inches in length, and set so that its top end was about 1 foot below the surface of the road. Here, as at West Base, great care was taken to reestablish the geodetic point in the same position in which it was found. This station stands in a bed of quicksand, which gave us considerable trouble in setting the barrel of concrete.

D (St. Ignace), 1851, 1853, 1896.—This station, as described in Professional Papers No. 24, "was situated on Point St. Ignace, at the summit of the hill on the southeast end of a crest of a rocky ridge. * * * The geodetic point was marked by a hole 2 inches in depth drilled in the solid limestone rock, 18 inches below the surface of the ground, and filled with broken nails." The station was re-marked by taking out the broken nails, drilling the hole 2 inches deeper and cementing in it, with Portland cement, a ⅜ by 4 inch brass rod, on the upper end of which was cut a +. Over this was set a cedar post projecting about 1 foot above ground, in the top end of which was driven a wire nail for a surface mark.

E (Rabbits Back), 1851, 1896.—This station, as described in Professional Papers No. 24, "was situated on the summit of Rabbits Back Peak, about 5 miles north of Point St. Ignace. * * * The geodetic point was marked by three 30-penny nails driven into a cleft of the rock." This station was found by finding the stump of the old center post. There is about 20 inches of dirt covering the rock into which the nails were driven. The station was re-marked by a limestone post having a dressed top, in which was cemented a ⅜ by 4 inch brass rod, with a + cut in its upper end. The center of the + was placed directly over the center of the cluster of nails. The top of the stone post is about level with the surface of the ground.

As stated above, the whole of the primary triangulation executed in connection with the resurvey of St. Marys River will be found on Pl. I. Aside from showing the triangulation completed during the last fiscal year, this plate has been prepared to show the whole triangulation net exactly as it was finished. Several of the earlier sketches show the work as it stood at the time they were made and do not embody all of the work done in the areas they cover. The system, it will be seen, makes a connection between the old triangulation of Lake Superior, starting from the side Gargantua-Mamainse, of the last triangle, Gargantua-Mamainse-Michipicoten, in the eastern end of the lake, and the Mackinaw base line on the south side of the Straits of Mackinac. A chain of triangles branching from this main system at the head of the St. Marys River follows it to Detour, and furnished the control for the secondary and tertiary systems upon which the topography is based.

All of the notes pertaining to the triangulation taken during the last year have been reduced and the results tabulated. The computations were made in duplicate by Asst. Engineer Thomas Russell and Recorder H. F. Johnson.

METHODS.

The methods pursued in both field and office work and the instruments used were the same as during the previous years of the survey, as described on page 3410 of the Report of the Chief of Engineers for 1894.

All targets, heliotropes, and instruments, when mounted for observing, were kept carefully centered over the geodetic point, so as to avoid all corrections for eccentric positions. The limits of error, ± 2 seconds for closing of horizon and ± 3 seconds for closing of triangles, were maintained.

In adjusting the triangulation the method of adjusting by quadrilaterals or small figures heretofore employed has been followed. The work of the past season was adjusted as three figures, the first one being the quadrilateral Iroquois-Duke-Robinson-Maple Hill; the second one of the hexagon, Robinson-Goose Island-Mackinac Island-St. Ignace-Rabbits Back-Maple Hill; and the third one the quadrilateral Mackinac Island-East Base-West Base-St. Ignace.

RESULTS.

Summary of the work for season of 1896.

Stations.	Primary angles.	Secondary angles.	Vertical angles.	Closing horizon.
Duke	6	2	2	—1.18
Maple Hill	9	2	5	+0.13
Robinson	10	7	8	—0.63
Goose Island	4	6	3	—1.71
Rabbits Back	7	8	5	—0.71
St. Ignace	9	11	5	—1.90
Mackinac Island	7	6	4	—0.69
West base	4	8	0	+0.88
East Base	4	4	0	—0.23
Magnetic station at West Base	....	2	....	....
Total	60	56	32	....

The following comparison between the lengths of the triangle sides from the work of the old survey and that of the past season where the two systems overlap may be of interest:

Triangle.	Observed angles.				Length of sides.		Difference.
	Old values.			New values.	Old values.	New values.	
	°	′	″	″	*Meters.*	*Meters.*	*Meters.*
East Base	54	33	42.80	47.42	8,754.918	8,754.100	0.818
West Base	86	40	32.84	31.55	10,736.716	10,735.593	1.123
St. Ignace	37	45	38.18	39.61	6,580.270	6,579.569	0.701
			53.82	58.58			
East Base	33	58	26.90	26.99	7,318.465	7,317.690	0.765
St. Ignace	90	57	30.30	29.80	13,094.467	13,093.100	1.367
Mackinac Island	55	04	03.15	03.58	....	....	....
			00.35	00.37			
Rabbits Back	42	25	56.62	55.48	....	....	....
Mackinac Island	45	29	06.32	07.09	7,734.414	7,733.650	0.764
St. Ignace	92	04	58.98	55.33	10,839.541	10.838.382	1.159
			01.92	57.90			

The new values are the smaller, the greatest difference being 1.367 meters in the length of the line East Base to Mackinac Island. These new values are those brought from the Soo base line, the length of which depends upon the length of steel tape No. III, belonging to the Missouri River Commission, with which it was measured. The constants of this tape are given on page 4360 of the Report of the Chief of Engineers for 1893.

As will be seen from the table above, the length of the Mackinaw base as derived from the Soo base is 0.701 meter shorter than the value given in Professional Papers No. 24. The comparison of these results with the measurement of the Mackinaw base line made during the present year, which will be described later in this report, can not be given at this writing, for the reason that the absolute lengths of the wires with which it was measured have not yet been determined. In our last year's report we gave the position of △ Gargantua, on the north shore of Lake Superior, as derived from the latitude and longitude observed at Fort Howard and also as determined from the Soo Observatory. This comparison gave the latitude as carried from the Soo Observatory + 0″.59, greater than that brought from Fort Howard, while the longitude was —8″.19, less. The past season's work gives us an opportunity of again making a comparison of the latitudes and longitudes as derived from these different bases, and at △ West Base we have:

Location.	Latitude.			Longitude.		
	°	′	″	°	′	″
West Base from Fort Howard	45	47	13.80	84	46	22.40
West Base from Soo Observatory	45	47	14.995	84	46	14.815
Differences			+ 1.95			— 7.585

It will be noticed that these differences are in the same direction as those of last year, and are very similar in amount. Evidently there is a discrepancy other than station error between the longitudes derived from Fort Howard and those brought from the Soo Observatory, and it would seem advisable to make a determination of the difference in longitude between Cambridge and Sault Ste. Marie, as has been contemplated, in order to settle upon a value that should be used before the question becomes further complicated.

The tables giving the results of the triangulation, the adjustment, the geographic positions of the primary and secondary points, will be found appended to the report of Assistant Engineer Thomas Russell, marked C.

ASTRONOMICAL OBSERVATIONS.

The astronomical work during the season of 1896 consisted of four nights' observations for azimuth between September 27 and October 2, at △ West Base. On these four nights eight determinations of the azimuth of the primary line West Base-St. Ignace were made. Four determinations were obtained on the night of September 27 α Ursæ Minoris, Groombridge 750 and 51 Cephei being observed at eastern elongation and δ Ursæ Minoris at western elongation; α Ursæ Minoris was observed on September 28 at eastern elongation; on October 1 α Ursæ Minoris and Groombridge 750 were observed at eastern elongation, and on October 2 α Ursæ Minoris at eastern elongation.

The instrument used was Troughton & Simms theodolite No. 3, and the method followed that given in Appendix No. 14 of the Coast and Geodetic Survey report for 1880.

The time was taken from sidereal chronometer, Isaiah Lukens No. 141, its errors being determined on each night on which observations were made. The declination and right ascensions of the circumpolar stars used, and also the time stars observed, were taken from the Berliner Astronomisches Jahrbuch.

The azimuth mark consisted of a lantern placed in a box in the side of which was cut a slit one-half inch wide by 4 inches long. This box was so placed that the center of the lantern occupied a position directly over the geodetic point at △ St. Ignace, and the slit was centered on the line to West Base.

The observations have been reduced in duplicate by Assistant Engineer T. Russell and Recorder H. F. Johnson. The results are given below:

Date.	Star used.	Observed azimuth, West Base-St. Ignace.		
		°	′	″
1896.				
September 27	α U. Minoris	213	53	30.33
Do	Groombridge 750			28.13
Do	δ U. Minoris			24.51*
Do	51 Cephei			30.98
September 28	α U. Minoris			29.36
October 1	do			27.74
Do	Groombridge 750			27.75
October 2	α U. Minoris			24.33*
Mean		213	53	27.89
Mean, rejecting azimuth marked *				29.05

The observations on Groombridge 750 on October 1 were made by Mr. H. F. Johnson. The results on δ U. Minoris on September 27 and on α U. Minoris on October 2 seem to be small in comparison with the other values, but are given for the reason that by incorporating them the range in the observations is not large.

The azimuth brought by the triangulation from the azimuth determined at the Soo Observatory for the line above determined is 213° 53′ 29.55″, agreeing with the observed value within 1.66″. The azimuth published in Professional Papers No. 24 for this same line is 213° 53′ 44.26″, which is 16.37″ larger than the observed value.

MAGNETIC WORK.

During the past fiscal year observations for determining the magnetic declination were made near five of the primary triangulation stations by the angle-reading parties. These five stations are: Maple Hill, Robinson, Goose Island, West Base, and Mackinac Island, the location of which may be seen on Pl. I.

The instrument used was a Fauth magnetometer, the same as used the previous year, but somewhat improved, as mentioned in my last annual report.

The magnetic station near West Base, McGulpins Point, Straits of Mackinac, was marked in what is thought will be a permanent manner, so as to preserve it for future use. This station marks the northeast corner of the light-house reserve, and is within 10 feet of the high-water line along the shore. It is marked by a pillar of concrete 8 inches square by 8 feet long, 4 feet of which goes in the ground. On the top of the pillar are the marks U. S. + 1896. While making the observations the magnetometer was mounted directly on this pillar. The azimuth to St. Helena Island light-house, center of lantern, is 135° 59′ 54.47″, which makes a convenient reference for any future determination at this point.

In the table which follows is given the observer, the date, the latitude and longitude of the station, the resulting declination, and the time of the elongations.

Table of results; magnetic observations during 1896.

Station, number, place, etc.	Date.	Observed declination (west).	Time of elongation (ninetieth meridian time).		Remarks.
			Eastern.	Western.	
	1896.	° ′	a. m.	p. m.	
1. Near △ Maple Hill, 121.6 meters; azimuth 6° 36.8′ from △.	Aug. 6 Aug. 7 Aug. 10	1 00.9 0 57.8 0 44.2	7.15 7.20 7.40	12.30 12.10 12.40	T. Russell, assistant engineer, observer. Latitude 46° 09.4′; longitude 84° 46.9′.
Mean	....	0 54.3			
2. Near △ Robinson, 78.9 meters; azimuth 339° 50.3′ from △.	Aug. 21 Aug. 22 Aug. 24	1 31.0 1 29.6 1 32.4	7.00 7.10 7.10	12.30 12.20 [a]11.45	Latitude 46° 04.1′; longitude 84° 21.9′. Assistant Engineer T. Russell, observer.
Mean	....	1 31.0			
3. Near △ Goose Island, 65 meters; azimuth 320° 47.6′ from △.	Sept. 25 Sept. 26 Sept. 27	1 08.8 1 08.6 1 06.2	7.10 7.15 7.10	12.10 1.20 12.10	Latitude 45° 55.6′; longitude 84° 25.8′. Assistant Engineer T. Russell, observer.
Mean	....	1 07.9			
4. Near △ West Base (of Mackinaw base line).	Nov. 2 Nov. 3	0 49.2 1 00.5	7.40 7.35	12.30 12.30	Latitude 45° 47.3′; longitude 84° 46.2′. Assistant Engineer E. E. Haskell, observer. This station is a concrete pillar, 4 feet above ground, marking one boundary of McGulpins Point. Light-house reserve at the shore of the straits.
Mean	....	0 54.8			
5. Near △ Mackinac Island..	Nov. 16 Nov. 17 Nov. 19	1 46.5 1 49.7 1 44.3	7.35 7.45 7.50	12.55 12.45 12.55	Latitude 45° 51.4′; longitude 84° 36.8′. Assistant Engineer E. E. Haskell, observer. This station is a wooden post close to NW. corner of the parade ground.
Mean	....	1 46.8			

[a] a. m.

THE REMEASUREMENT OF THE MACKINAW BASE LINE.

I quote the following concerning the Mackinaw base line from Professional Papers No. 24, page 588:

"A base line about 4 miles long, in the first section, was measured by Capt. T. J. Lee, Topographical Engineers, in 1854, on the south side of the Straits of Mackinac. (See Report of Chief of Topographical Engineers, U. S. A., for 1854.) Its length depended on that of the 15-foot brass bar of the lake survey, whose length at the time was not known with great precision. Würdemann had assigned a length and a coefficient of expansion to this bar, but nothing is known of the methods by which he determined them, and it is now known that the expansion assigned by him, namely, 0.0017 inch per degree Fahrenheit, is largely in error. As the length of this bar has been changed since the measurement of the base by the insertion of agate plates in its ends, it is impossible now to determine its original length. Accordingly, the sides of the triangulation have been made to depend on the side Door Bluff-Cedar River of the main triangulation, both for length and azimuth, this being the nearest side for which identity between the old and new stations was certain."

As the base line was to be the objective point of the triangulation, and in view of the uncertainty as to its length, we decided to remeasure it, the marks at its ends having been found intact, as heretofore explained.

After this decision was reached there came the question of method to be followed. The precision attained with long tapes, their small cost, and the rapidity with which a line is measured with them, were strong points in the recommendation of their use. The certainty, however, of finding their temperature from thermometers is so questionable that it was considered advisable, if we were to adopt them, to seek other means of observing this quantity. While discussing this subject, Mr. E. S. Wheeler suggested the use of brass and steel wires, taking, say, 10 wires or tapes of each metal 100 meters long, placing those of the same kind, properly supported, end to end, and the two metals side by side, providing means for stretching each tape independently, at the same time bringing the rear mark on any tape coincident with the forward mark on the succeeding tape of the same metal, and finally reading the position of the forward ends of the foremost tapes on scales properly placed for the purpose. This would be practically using two tapes of different metals, each a kilometer in length, and determining their temperature from their difference in expansion. His idea further was to make a series of readings with these tapes, covering, say, a period of twenty-four hours, the temperature in the meantime passing through a maximum and a minimum, and obtain, instead of one, two hundred or more measurements, from which the absolute length of a section of the base would be determined.

The expansion of a steel tape a kilometer long for 1° C. is 12 millimeters, and the same for a brass tape of this length is 19 millimeters. Or for every change of 1° C. we have a relative change in the lengths of the wires of 7 millimeters, which is a very obvious quantity.

Mr. Wheeler's suggestion led to the question: Why not use tapes a kilometer in length, provided they can be supported in such a manner that a uniform tension can be maintained throughout their entire length? Experiments were undertaken in this direction, and we found that by the use of hanging supports 4 feet in length, placed every 10 meters and carefully plumbed, spring balances placed at each end of the wire for indicating the tension could be brought into coincidence. In actual work later, these supports were made 5 feet in length, in order to give greater security to the method.

With this success we ordered 2 piano wires, 1 brass-spring wire and 1 phosphor-bronze wire of the requisite length and of No. 16 iron and steel wire gauge. The phosphor-bronze wire was selected, in a measure, as an experiment, its composition greatly resembling brass, while it is much more elastic. On the receipt of the wires, although they had been ordered drawn in coils of large diameters, it was found that the brass wire had taken on a set in conformity with the size of the coil and so would not straighten out when unwound. It was therefore returned to the mills, and as another one free from this defect could not be obtained in time, the measurement was made with the phosphor-bronze and the two steel wires.

The wires were marked at each 100-meter point of their length by having soldered to them a brass bead made in a lathe on which was cut a fine graduative mark. Preliminary to their use in the field they were taken to the comparator here on the canal grounds and each 100-meter section of each steel wire compared with the corresponding section of the phosphor-bronze wire and with the standard 100 meters of the comparator. The wires were wound on reels about 30 inches in diameter, which were inclosed in boxes made for the purpose, which protected them while in transportation and when not in use.

The Mackinaw base line extends from a point which is directly in front of McGulpins Point Light-House in a direction S. 58° E. for 4 miles. When the line was first cut through in the early fifties, by far the largest part was through woods, a short distance at the west end only being in clearing. All but about 1 mile of the base line has been used as a wagon road, although 1 mile more has never been very extensively so used. The western mile required considerable cutting of timber, as the trees had grown so that they made a continuous archway of the road. The second mile required comparatively little cutting, but a large part of the third was through a heavy growth of small cedars, requiring considerable work. The fourth mile was in the road and took no trouble to prepare.

The line is rather a rough one for a base line, still about as good as it is possible to find in the locality. West Base is about 68 feet above Lake Michigan, and the first kilometer from it is about level. The ground then takes a gradual uneven slant until the tracks of the Grand Rapids and Indiana Railway are reached, 1.8 kilometers farther, where the elevation is 31 feet above the lake. From this point the slant is more gradual until the end of the fourth kilometer is reached, where the ground is about 11 feet above the lake. The fifth kilometer and six-tenths of the next one are about level. The ground then rises more or less irregularly to East Base, which is 29 feet above the lake.

The marking and position of the base stations has already been described in connection with the work of the triangulation. The only other point on the line permanently marked is the end of the first kilometer from West Base, marked by a barrel of concrete set in the ground with the top 4 feet below the surface. In this is set flush with the top a brass rod 4 inches long, three-eighths of an inch in diameter with a + on its upper surface, one line of which is perpendicular to the base line. This marks the point between which and West Base about 600 measurements were taken, and may be made useful in future for testing kilometer wires.

The interval between July 1 and August 12 was spent at Sault Ste. Marie, completing the comparator which was in progress of construction and will be described later, marking the measuring wires, and comparing them previous to their use in the field. By August 12 the party was established in camp near West Base, and immediately began the preliminary work of clearing the base line, cutting stakes for supporting the wires, and building a few triangulation stations that were required in the vicinity.

As soon as the base line was cleared, a station 15 feet high was built at West Base, from the top of which a target of the same height could be seen on East Base. A transit line was then run through, and a hub, with a tack to indicate the line, set every 100 meters. A line of levels was next run and the elevation of the ground obtained at each 10-meter point, from which a profile was made of the entire line. On this profile was drawn a grade line in kilometer lengths, which represented the position the measuring wires would occupy when in place for a measurement. This profile also furnished the data for getting the length of the stakes to be driven at each 10-meter point, to carry the supporting hooks.

A kilometer section of the base was made ready for measurement by stretching a 100-meter wire, marked every 10 meters between the hubs previously driven, and setting with a transit a small stake directly on the line at every 10-meter point. The tall stakes for carrying the supporting hooks having been previously cut of proper length and sharpened, they were set by making a hole in the ground with an iron bar, about 6 inches to one side of the line at each 10-meter point, setting the stake therein and driving it firmly into the ground with a wooden maul from a step-ladder made for the purpose. The grade line for the wires, taken from the profile, was next marked on these stakes by driving a 6-penny wire nail into the line side of the stake. The supporting hooks were made from No. 18 steel wire, a hook like the one on the letter "t," about three-eighths of an inch wide and 1 inch deep, being turned at each end of a piece about 1 foot long. Pieces of galvanized sheet iron, 2 inches wide by 4 inches long, were turned at one edge into a tube about one-fourth of an inch in diameter, through which a 40-penny wire nail could be passed, and then driven into the stake. In the opposite edge of this piece of sheet iron were punched three small holes 1 inch apart, in which were tied pieces of fine braided silk fishing line 4 feet long, the hooks above mentioned being tied to the lower ends of these strings. For a kilometer, 99 sets of these supporting hooks were required, and they were all carefully constructed after the same pattern, so that it was only necessary, when putting them up, to hook the three hooks under the grade nail, draw the strings taut, and drive the 40-penny nail into the stake above, at right angles to the direction of the base line and as nearly horizontal as possible. The point of support for the middle hook—the middle hole in the piece of sheet iron—was then plumbed over the small stake set on the line by tamping the ground around the large stake. When not carrying the base wires, these supporting hooks were kept hooked under the grade nail to prevent them from being tangled up with each other by the wind.

A polished brass plate, 2 by 4 inches and one-eighth of an inch thick, on which had been cut two fine lines, through the middle, at right angles to each other, was set at the elevation of the grade line, directly over the geodetic point at West Base. The intersection of the two lines was over the geodetic point and one of the lines was placed at right angles to the base line. Great care was taken in setting this plate to insure the mark on it being directly over the underground mark, for from it all measurements were made. At the end of each kilometer two very large posts were set, about 4 feet apart, with their centers directly on the base line. These were sawed off at the proper height so that a 3-inch plank, 4 feet long, could be spiked to them and have its top surface 1 inch below the grade line. A piece of pine board 6 inches wide, about 2 feet long, and fifteen-sixteenths of an inch thick, in one side of which, 4 inches from one end, was inlaid, one-sixteenth of an inch, a brass plate, similar to the one used at West Base, except that one of its edges, dressed straight, was used for the end mark, against which was set one end of each of the quarter-meter scales. The scales were fastened to the board, their graduated edges 1 inch apart, the edge of the middle scale on the center line of the board. This board was fastened to the plank on the posts so that its center line was on the base line, and the scales which it carried were so placed that the forward marks on the measuring wires, when stretched for measuring, would fall near the middle of the scales, thus allowing for expansion and contraction.

With the stakes cut and sharpened ready for driving, a kilometer could be staked and made ready for measuring in one day's work with the whole party.

To hold the measuring wires at the rear end of a kilometer, a piece of pine plank, 1 foot wide and 2 long, was secured just back of the mark. On this were fastened three clamps for holding the wires, provided with screws for bringing the rear marks on the measuring wires into coincidence with the mark from which the measurement began.

The pull on the wires was given by spring balances. On a pine plank, 2 inches thick, 1 foot wide, and 10 feet long, was provided three blocks working in slides, on each one of which rested, securely fastened, a spring balance. A combination of levers and screws provided means for a rapid and slow movement of the blocks, so that the tension of 25 pounds could be put and maintained in each wire with comparative ease. This stretcher was placed on the line about 15 feet forward of the end of the kilometer and at the proper height to bring the measuring wires, when fastened to the balances, to the elevation of the grade line.

The personnel of the party consisted of one man to tend the spring balances, an observer to read the forward ends of the wires on the scales, and a recorder to record them; a man stationed at each of the following points, the 100, 300, 500, 700, and 900 meter points to assist in plumbing supports, protect the wires from injury by cattle roaming at large, and read thermometers; and an observer to keep the rear ends of the wires in coincidence with the rear mark; in all, nine persons. This number, however, is too small, unless the base line is well cleared, and there is little or no danger of being disturbed by stock.

The measurement of a kilometer took place as follows: The reels containing the measuring wires were placed about 15 feet back of the mark from where the measurement was to begin and securely fastened in place. The ends of the three wires were run out and tied to a short stick in the order in which they were used in measuring. A man took this short stick in hand and marched forward with the wires, the reels in the meantime being tended to pay them out evenly. When 200 meters were out the man pulling the wires stopped, and a couple of pieces of wood about 5 inches long by 1 inch square, held together at one end by a screw, were clamped on to them, notches having been cut in one of the sticks in which the wires rested. A second man took hold of this clamp and a signal was given to move forward, and 200 meters more were run out, when a second clamp was put on and a third man took hold, and so on until the wires were out. The rear ends of the wires were then fastened in their respective clamps and a signal given to put them up in the supporting hooks. At this signal each man started from his clamp and began hooking up the wires, working toward the rear end of the kilometer. As soon as this was finished each wire was fastened to its respective spring balance, and the proper tension applied and maintained, one man devoting himself to this adjustment. The attendants, on the signal being given that the tension had been adjusted, began plumbing the supporting hooks, going first over the line and plumbing them approximately by eye, and following with a small weight of about 1 pound, which was hooked to a supporting hook, the wire lifted out and returned when the hook had been brought plumb. It was customary to plumb through the length of the kilometer six times before starting a measurement, although it was found by trial that only four times were actually required.

The plumbing of the supporting hooks being finished, a flag was hoisted on a small pole at the forward end of the kilometer as a signal that on the next even minute observations would begin. All watches were previously compared and at the even minutes the three scales were read as nearly simultaneously as possible, the proper tension on each wire having been noted. The reading of each thermometer was also taken and recorded, the observer at the rear end in the meantime having seen that the rear marks were in place. An observation was made every minute until the wires had expanded or contracted about 1 centimeter, throwing the supporting hooks out of plumb enough to require attention, when a signal would be given, by dropping the flag that had been raised, that the supporting hooks were to be replumbed. Each attendant would then plumb backward and forward over the 200 meters that he cared for, the forward and rear observers in the meantime plumbing the supports on the first and last 100 meters. This replumbing finished, the measurement proceeded as before, a whole day being devoted to the 1 kilometer, and as a rule 200 measurements of it were obtained.

The thermometers used were made by Henry J. Green, of Brooklyn, N. Y.; they were about 1 foot long, graduated and figured on the stem, centigrade scale to fifths of a degree. In use they were hung from the end of a small stick nailed in a horizontal position to the large stake, with the bulb at just the height of the wires and about a foot from the stake. These thermometers were very carefully compared with each other previous to their use in the field, and since then have been very carefully tested at the Bureau of Weights and Measures, United States Coast and Geodetic Survey, Washington, D. C.

The following is a table of their corrections:

Temperature.	U. S. E. 8977.	U. S. E. 8979.	U. S. E. 9006.	U. S. E. 9007.	U. S. E. 9008.	U. S. E. 9009.	U. S. E. 9010.
°	°	°	°	°	°	°	°
0.0	−0.08	−0.06	−0.10	−0.07	−0.05	−0.02	−0.04
2.5	−0.04	−0.06	−0.12	−0.10	−0.06	−0.07	−0.08
5.0	−0.08	−0.08	−0.11	−0.09	−0.08	−0.08	−0.08
7.5	−0.10	−0.10	−0.13	−0.11	−0.07	−0.10	−0.08
10.0	−0.13	−0.13	−0.15	−0.13	−0.12	−0.13	−0.12
12.5	−0.18	−0.12	−0.20	−0.14	−0.11	−0.18	−0.16
15.0	−0.10	−0.10	−0.17	−0.15	−0.11	−0.09	−0.11
17.5	−0.10	−0.09	−0.18	−0.13	−0.14	−0.08	−0.11
20.0	−0.11	−0.12	−0.19	−0.14	−0.15	−0.10	−0.13
22.5	−0.10	−0.10	−0.18	−0.13	−0.16	−0.09	−0.11
25.0	−0.10	−0.10	−0.21	−0.13	−0.11	−0.10	−0.13
27.5	−0.11	−0.10	−0.22	−0.10	−0.10	−0.10	−0.10
30.0	−0.11	−0.07	−0.21	−0.08	−0.08	−0.12	−0.10
32.5	−0.13	−0.10	−0.20	−0.10	−0.13	−0.13	−0.09
35.0	−0.15	−0.14	−0.17	−0.14	−0.14	−0.15	−0.15
37.5	−0.15	−0.09	−0.18	−0.14	−0.15	−0.16	−0.13
40.0	−0.15	−0.11	−0.18	−0.12	−0.11	−0.15	−0.13
42.5	−0.13	−0.14	−0.21	−0.14	−0.14	−0.19	−0.14
45.0	−0.14	−0.14	−0.23	−0.12	−0.14	−0.21	−0.16
47.5	−0.12	−0.19	−0.26	−0.14	−0.11	−0.23	−0.16
50.0	−0.16	−0.23	−0.30	−0.13	−0.12	−0.27	−0.13

Each kilometer of the base line was measured in the same manner as the first, the last or fractional one of 600 meters being measured by using the first 600 meters of each wire. The distance from the 6,600-meter point back to East Base—the base being approximately 6,579.5 meters long—was measured with a 100-foot Chesterman steel tape, which will be very carefully tested before the final length of the base is announced.

The absolute length of the base line can not be given at this writing, for the reason that the absolute length of each of the kilometer wires at a given temperature is not yet known. Everything is in readiness for determining it, and it will be given, together with the length of the base, in our next annual report.

The method promises well, as will be seen when we are able to give the results. The experience gained during the past season, however, brought out suggestions for improvements, chief among which is an automatic method of applying the tension. This will prove of great advantage, as, in general, it will shorten the time of reading the scales, while it will do away with the uncertainty that a spring balance may not always indicate the same number of pounds of pull.

THE COMPARATOR AND COMPARING ROOM.

The necessity of having some means of testing the length of the various steel tapes and wires used in connection with the survey of the river and harbor improvements in this district suggested long ago the advisability of having means here at hand for this purpose, and this office has been gradually working toward this end. It has in its possession the four microscopes and the cut-off of the Repsold base-measuring apparatus, and standard meters "M.T. 1876" and "R. 1876," that were the property of the old Lake Survey which is substantially all that is required in the way of instruments. What else was wanted were a few auxiliaries, a comparing room, and a place for a comparator for testing long tapes. A place for a comparing room was readily found in one of the buildings on the canal grounds. A place for a comparator was also found on the canal grounds between the canal and the rapids near the movable dam, and the construction of this will now be briefly described.

At the place mentioned the rock in situ—Potsdam sandstone—which underlies this vicinity, reaches within about 4 feet of the surface of the ground. Beginning at a convenient point a line was staked out about parallel to the canal and 118 feet from it, along which the distances, 100 feet, 50 meters, 100 meters, and 500 feet, were carefully marked off from the easternmost point. At each mark a hole was dug about 5 feet square down to the rock and a pier of concrete for holding a microscope erected. The bases of these piers are about 4 feet square. They maintain this size for about 3 feet, when they reduce to 2 feet square for the remainder of their height, their face side being vertical from top to bottom. The faces of these piers were all on the same straight line and at the respective distances indicated above, center to center—from the first or easternmost pier. The tops of the piers were at the same elevation, and had set in them a suitable iron casting for supporting one of the microscopes and carrying in connection therewith a scale on which readings could be made.

After the concrete in these piers had set so that the molds in which they were cast could be removed, a stonecutter was employed, and the rock in situ in front of each pier for an area 1 foot square, the center of which fell directly underneath the microscope when mounted, was cut down to the grade line of the rock in front of the pier where the rock was lowest. In the center of this area was drilled a hole about 3 inches in diameter and 5 inches deep in which was cemented, with Portland cement, a large brass plug about 5 inches long, 1¼ inches in diameter at its top, and 2 inches in diameter at its base. Its top end projects about one-half an inch above the surrounding rock, and is covered with a nicely fitting brass cap that protects from injury the small hole drilled vertically in the center of the plug to receive the steel pin of the cut-off. These five brass plugs were set at the same elevation and on the same straight line as nearly as it was possible to set them. The cut-off when set on one of these plugs has its scale directly under the microscope mounted on the pier.

Each brass plug is surrounded with a wall of concrete inclosing an area about 3 feet square, reaching to the surface of the ground. This area is covered with a platform, and over each pier and platform is a small house 4 by 6 feet 4 feet high, to protect all from the weather. At the beginning of cold weather in the fall the wells in which the plugs stand are filled with sand to keep out the frost. It is thought that the lengths here marked will remain absolutely unchanged, unless there is a disturbance of the earth's crust.

These various lengths have yet to be determined in terms of one or the other of the standard meters above referred to. To accomplish this a steel bar, X-shape in cross-section and 8 meters long, has been selected, dressed to proper shape, and has had inserted in it, near its neutral axis, silver plugs on which are fine graduations marking each meter length. A trough has been constructed, suitably equipped, in which this bar can be used as a measure of length, being packed in ice, thus attaining the temperature of that material when melting. The various lengths of the comparator will be determined in terms of this 8-meter bar, and its length in terms of one of the standard meters.

For getting the length of this 8-meter bar in terms of one of the standard meters a comparing room has been fitted up as follows: This room is in warehouse No. 4, on the canal grounds, and is 9 by 36 feet in size, On a line running longitudinally through the middle of this room and 11.45 feet center to center, are built three piers of concrete. These piers start from a point 5 feet below the surface of the ground and are 4 feet square for the first 3 feet of their height, and 2 feet squre for the remaining 5 feet. Their tops are at the same elevation, and resting on and bolted to them by long bolts set in the concrete when the piers were constructed is a beam 28 feet long, built of three 3 by 12 inch spruce planks piled one above the other and firmly bolted together. On top of this beam and bolted to it are nine iron plates set at the distance of 1 meter apart for supporting the microscopes.

In front of and on a line parallel to the piers stand five large oak posts set about 5 feet in the ground, to the tops of which are bolted two 3 by 10 inch spruce stringers. Resting on these stringers is the track on which the trough with the 8-meter bar rests. This track is entirely independent of the piers. Provision is made so that the standard meter can be placed in the trough beside the 8-meter bar for the purpose of comparing it in turn with each of the meters of the 8-meter bar, a side movement of the trough bringing first one and then the other of the standards under the microscopes.

TOPOGRAPHIC WORK.

On March 15, 1897, the topographic work, previously in charge of Asst. Engineer H. von Schon, was, on his being granted an indefinite leave of absence, assigned to me. The work executed since this date has been office work upon the unfinished topographic and hydrographic sheets, but to make this subject perfectly clear a brief review will be given of the work accomplished by Mr. von Schon and his party during the fiscal year just ended.

This work was the completion of the unfinished topography and hydrography for new chart No. 1 of St. Marys River and the completion of the line of precise levels from T. B. M. No. 8, south of the Munuscong River to Detour Light-House. Chart No. 1 covers the river from the head of Mud Lake to Lake Huron, a distance of 24 miles, and extends eastward over the foot of St. Joseph Island, Potagannissing Bay, and Drummond Island to Sulphur Island Light, covering an area of approximately 472 square miles.

Attention is invited to Mr. von Schon's report, marked E, page 4056, Report of the Chief of Engineers for 1896, for a statement showing the condition of the work at the close of the last fiscal year. Briefly speaking, the topography and hydrography within the area covered by chart No. 1, was about one-third finished. The topography on both sides of the river had been completed to the foot of St. Joseph Island, including that of the south shore of this island as far eastward as Grande Point. The topography of several of the islands in the northern half of Potagannissing Bay had also been obtained. The hydrography of the river had been finished to Detour Lumber Company's dock at Detour, by the ice survey in March, 1896.

During the past season the secondary and tertiary triangulation for controlling the topography and hydrography of Potagannissing Bay described in Mr. von Schon's last year's report, was extended by the addition of 2 quadrilaterals to the secondary system and 31 quadrilaterals to the tertiary system, covering completely the area surveyed.

The topography of all the islands lying in Potagannissing Bay, that of the shore line of Drummond Island from Poe Point on the north shore, westward around through Detour Passage and along the south shore to and including Whitney Bay was obtained. Also the topography of the right bank of the river from the point where the work of the previous year ended (before mentioned) down to the mouth of the river and a short distance westward along the Lake Huron shore.

In hydrographic work Potagannissing Bay and Detour Passage from Detour Lumber Company's dock to the mouth of the river were sounded.

The precise levels run during the season were the completion of the projected line from Sault Ste. Marie to Detour Light House, the part run being from T. B. M. No. 8, about 3 miles south of the Big Munuscong River to Detour Light, a distance of 35 miles.

The topography and hydrography are plotted on field or plane table sheets that are 22 by 25 inches in size. The work of the past season overlapped on 10 of the sheets of the year previous and required 19 new sheets. Tracings are made on vellum of these field sheets that are 25 by 45 inches in size. These tracings are called record-sheet tracings. The work of the season overlaps on 2 record sheets of last season and furnishes 9 new sheets.

The office work of reducing the notes of the secondary and tertiary triangulation on the preliminary computation of the line of precise levels were completed at the time the work was assigned to me. The field notes of the topography and hydrography were also about nine-tenths plotted.

The progress made since March 15 has been the completion of the plotting of the topographic and hydrographic notes, thus completing all of the plane-table sheets. Record sheets No. 29, Milford Haven; No. 30, Serpent; No. 31, Sulphur Island Light, have been made, leaving record sheets No. 32, Chippewa; No. 33, Potagannissing; No. 34, Maud Bay; No. 35, Detour; and No. 36, Detour Passage, to be drawn in order to complete the work.

The press of other work has prevented the checking of the computations of the precise level line, and the results from this work can not, therefore, be given at this writing.

There were associated with Mr. Von Schon as his assistants, Recorders Andrew J. Swift and Howard N. Eavenson; and also Rodmen Murray Blanchard and Charles E. Thompson, who assisted at instrument work in the field. Mr. Eavenson ran the line of precise levels and also made the preliminary computations of them. He resigned his position February 9, 1897, since when Mr. Swift has been the only assistant engaged upon the topographical work. Mr. Swift has also made, in connection with his regular work, most of the sketches for our annual reports. Tables Nos. 1, 2, 3, and 4, giving the results of the secondary and tertiary triangulation in Potagannissing Bay, are hereto appended.

Very respectfully, your obedient servant,

E. E. Haskell, *Assistant Engineer.*

Mr. E. S. Wheeler, *Assistant Engineer.*

TABLE No. 1.—*Secondary triangulation—Potagannissing Bay.*

Stations.	Observed angles.			Local correction.	General correction.	Total correction.	Adjusted angles.			Logarithmic sines.	Logarithmic sides.	Sides.
	°	′	″	″	″	″	°	′	″		*Meters.*	*Meters.*
Burnt Point	47	38	40.4	+ 1.60	+0.84	+ 2.44	47	38	42.84	9.8686370	3.6418446	4,383.74
Bacon	55	03	45.5	− 1.05	−0.84	− 1.89	55	03	43.61	9.9136938	3.6869014	4,862.97
Burnt Island	77	17	30.9	+ 2.65	0.00	+ 2.65	77	17	33.55	9.9892301	3.7624377	5,786.79
Burnt Point	17	47	59.2	− 1.05	+2.63	+ 1.58	17	48	00.78	9.4852939	3.6781547	4,766.008
Bacon	140	24	48.0	− 5.05	−0.55	− 5.60	140	24	42.40	9.8043205	3.9971813	9,935.31
Harbor Island	21	47	22.9	− 4.00	−2.08	− 6.08	21	47	16.82	9.5695769	3.7624377	5,786.79
Burnt Point	29	50	41.2	+ 2.65	−1.79	+ 0.86	29	50	42.06	9.6969289	3.7929797	6,208.40
Harbor Island	22	56	31.1	− 0.30	+2.35	+ 2.05	22	56	33.15	9.5908506	3.6869014	4,862.97
Burnt Island	127	12	43.0	+ 2.35	−0.56	+ 1.79	127	12	44.79	9.9011306	3.9971813	9,935.31
Bacon	85	21	02.5	− 4.00	+0.29	− 3.71	85	20	58.79	9.9985680	3.7929796	6,208.40
Harbor Island	44	43	54.0	− 4.30	+0.27	− 4.03	44	43	49.97	9.8474329	3.6418445	4,383.74
Burnt Island	49	55	12.1	− 0.30	−0.56	− 0.86	49	55	11.24	9.8837431	3.6781547	4,766.008
Harbor Island	71	29	12.6	+ 4.25	+0.03	+ 4.28	71	29	16.88	9.9769262	3.8674360	7,369.47
Burnt Island	55	29	25.6	+ 1.29	−0.13	+ 1.16	55	29	26.76	9.9159456	3.8064554	6,404.06
Chippewa	53	01	13.3	+ 2.96	+0.11	+ 3.07	53	01	16.37	9.9024698	3.7929796	6,208.40
Harbor Island	29	19	05.9	+ 1.29	+0.08	+ 1.37	29	19	07.27	9.6899007	3.7357245	5,441.57
Burnt Island	116	43	02.0	+ 0.70	−0.06	+ 0.64	116	43	02.64	9.9509657	3.9967895	9,926.35
Kocruish	33	57	50.7	− 0.59	−0.02	− 0.61	33	57	50.09	9.7471559	3.7929797	6,208.40
Harbor Island	42	10	06.7	+ 2.96	−0.05	+ 2.91	42	10	09.61	9.8269320	3.8281178	6,731.59
Kocruish	39	41	29.9	+ 1.09	+0.07	+ 1.16	39	41	31.06	9.8052696	3.8064554	6,404.06
Chippewa	98	08	15.3	+ 4.05	−0.02	+ 4.03	98	08	19.33	9.9956037	3.9967895	9,926.35
Burnt Island	61	13	36.4	− 0.59	+0.07	− 0.52	61	13	35.88	9.9427670	3.8281178	6,731.59
Kocruish	73	39	20.6	+ 0.50	+0.05	+ 0.55	73	39	21.15	9.9820852	3.8674360	7,369.47
Chippewa	45	07	02.0	+ 1.09	−0.13	+ 0.96	45	07	02.96	9.8503737	3.7357245	5,441.57
Kocruish	67	33	12.9	− 3.65	−0.38	− 4.03	67	33	08.87	9.9657798	3.9319008	8,548.71
Chippewa	65	44	54.8	− 4.05	−0.10	− 4.15	65	44	50.65	9.9598726	3.9259936	8,433.22
Serpent	46	41	59.6	+ 0.40	+0.49	+ 0.89	46	42	00.49	9.8619968	3.8281178	6,731.59
Chippewa	43	09	59.0	+ 3.30	+0.44	+ 3.74	43	10	02.74	9.8351403	3.8398004	6,915.13
Sulphur Island Light	57	44	56.79	+11.05	−0.25	+10.80	57	45	07.59	9.9272407	3.9319008	8,548.71
Serpent	79	04	42.1	+ 7.76	−0.20	+ 7.56	79	04	49.66	9.9920647	3.9967248	9,924.87
Kocruish	43	20	32.8	− 4.05	+0.60	− 3.45	43	20	29.35	9.8365426	3.9967249	9,924.87
Chippewa	108	54	53.8	− 0.75	+0.34	− 0.41	108	54	53.39	9.9758918	4.1360741	13,679.62
Sulphur Island Light	27	44	34.91	+ 3.30	−0.94	+ 2.36	27	44	37.27	9.6679356	3.8281179	6,731.60

Kocruish	24	12	40.1	+ 0.40	−0.98	− 0.58	24	12	39.52	9.6125874	3.8398004	6,915.13
Sulphur Island Light	30	00	21.88	+ 7.75	+0.69	+ 8.44	30	00	30.32	9.6990806	3.9259936	8,433.22
Serpent	125	46	41.7	+ 8.16	+0.20	+ 8.45	125	46	50.15	9.9091611	4.1360741	13,679.63
Kocruish	6	26	21.5	− 2.16	−5.05	− 7.21	6	26	14.29	9.0496672	3.4663032	2,926.19
252	162	50	57.5	− 3.60	+1.57	− 2.03	162	50	55.47	9.4696678	3.8863038	7,696.69
Grande Point	10	42	48.2	− 1.44	+3.48	+ 2.04	10	42	50.24	9.2692933	3.6859293	4,852.10
Kocruish	60	05	21.7	− 0.94	+2.03	+ 1.09	60	05	22.79	9.9379228	3.9085891	8,101.01
Serpent	55	26	29.0	− 1.15	+0.45	− 0.70	55	26	28.30	9.9156970	3.8863038	7,696.69
Grande Point	64	28	11.6	− 0.21	−2.48	− 2.69	64	28	08.91	9.9553765	3.9259933	8,433.22
252	79	04	31.9	− 2.16	+2.73	+ 0.57	79	04	32.47	9.9920577	3.9259936	8,433.22
Kocruish	66	31	43.2	− 3.10	−3.02	− 6.12	66	31	37.08	9.9624866	3.8964225	7,878.12
Serpent	34	23	51.1	− 0.94	+0.29	− 0.65	34	23	50.45	9.7519937	3.6859296	4,852.10
252	83	46	25.6	− 1.44	−1.16	− 2.60	83	46	23.00	9.9974801	3.9085893	8,101.01
Serpent	21	02	37.9	− 0.21	+0.16	− 0.05	21	02	37.85	9.5551940	3.4663032	2,926.19
Grande Point	75	10	59.8	− 1.65	+1.00	− 0.65	75	10	59.15	9.9853183	3.8964225	7,878.12
Serpent	28	07	27.9	+ 2.14	+2.53	+ 4.67	28	07	32.57	9.6733967	3.6024269	4.003.38
343	83	24	19.0	+ 1.40	−0.78	+ 0.62	83	24	19.62	9.9971170	3.9261472	8,436.21
345	68	28	10.3	− 0.74	−1.75	− 2.49	68	28	07.81	9.9685848	3.8976150	7,899.78
Serpent	39	22	03.9	+ 1.99	−1.56	+ 0.43	39	22	04.33	9.8022927	3.7296092	5.365.49
345	54	50	02.6	− 0.89	+2.81	+ 1.92	54	50	04.52	9.9124839	3.8398004	6,915.13
Sulphur Island Light	85	47	51.8	+ 1.10	−1.25	− 0.15	85	47	51.15	9.9988307	3.9261472	8.436.21
343	32	49	58.8	− 0.74	+2.26	+ 1.52	32	50	00.32	9.7341582	3.7296091	5,365.49
345	123	18	12.9	− 1.63	−1.06	− 0.57	123	18	12.33	9.9220892	3.9175401	8,270.66
Sulphur Island Light	23	51	51.55	− 0.89	−3.31	− 4.20	23	51	47.35	9.6069760	3.6024260	4,003.38
343	50	34	20.2	+ 2.14	−3.04	− 0.90	50	34	19.30	9.8878555	3.8398004	6,915.13
Sulphur Island Light	61	55	59.75	+ 1.99	+2.06	+ 4.05	61	56	03.80	9.9456702	3.8976151	7,899.78
Serpent	67	29	31.8	+ 4.13	+0.97	+ 5.10	67	29	36.90	9.9655952	3.9175401	8,270.66

TABLE No. 2.—*Secondary triangulation—Potagannissing Bay—Geographical positions—The Clarke Spheroid of 1866.*

Stations.	Latitude.			Seconds.	Longitude.			Seconds.	Azimuth.			Back azimuth.			To station.	Distance.	Logarithms.
	°	'	"	*Meters.*	°	'	"	*Meters.*	°	'	"	°	'	"		*Meters.*	
Burnt Point	46	05	46.115	1,423.8	83	52	32.203	691.7	269	01	42.70	89	04	25.79	Burnt Island	4,862.97	3.6869014
									298	52	24.76	118	57	16.25	Harbor Island	9,935.81	3.9971813
									316	40	25.54	136	42	38.59	Bacon	5,786.79	3.7624377
Bacon	46	03	29.731	918.0	83	49	27.484	590.9	136	42	38.59	316	40	25.54	Burnt Point	5,786.79	3.7624377
									191	49	00.64	11	49	30.63	Burnt Island	4,383.74	3.6418446
									277	07	21.04	97	09	59.43	Harbor Island	4,766.008	3.6781547
Harbor Island	46	03	10.533	825.2	83	45	47.497	1,021.1	97	09	59.43	277	07	21.04	Bacon	4,766.008	3.6781547
									118	57	16.25	298	52	24.76	Burnt Point	9,935.81	3.9971813
									141	53	49.40	321	51	40.94	Burnt Island	6,208.40	3.7929796
									171	12	56.67	351	12	05.78	Kocruish	9,926.35	3.9967895
									218	23	06.28	33	25	04.45	Chippewa	6,404.06	3.8064554
Burnt Island	46	05	48.723	1,504.40	83	48	45.847	984.79	11	49	30.63	191	49	00.64	Bacon	4,383.74	3.6418446
									89	04	25.79	269	01	42.70	Burnt Point	4,862.97	3.6869014
									205	08	38.22	25	09	55.87	Kocruish	5,441.57	3.7357245
									266	22	14.21	86	26	20.93	Chippewa	7,369.47	3.8674360
									321	51	40.94	141	53	49.40	Harbor Island	6,208.40	3.7929796
Kocruish	46	08	28.250	872.24	83	46	58.124	1,247.93	25	09	55.87	205	08	38.22	Burnt Island	5,441.57	3.7357245
									183	52	03.06	3	52	20.53	Grande Point	7,696.69	3.8863038
									243	57	25.85	64	01	40.62	Serpent	8,433.22	3.9259936
									268	10	05.87	88	17	44.74	Sulphur Island Light	13,679.62	4.1360741
									311	30	34.72	131	33	23.89	Chippewa	6,731.59	3.8281178
									351	12	05.78	171	12	56.67	Harbor Island	9,926.35	3.9967895
Chippewa	46	06	03.689	113.90	83	43	03.433	73.74	33	25	04.45	218	23	06.28	Harbor Island	6,404.06	3.8064554
									86	26	20.93	266	22	14.21	Burnt Island	7,369.47	3.8674360
									131	33	23.89	311	30	34.72	Kocruish	6,731.59	3.8281178
									197	18	14.54	17	19	40.01	Serpent	8,548.71	3.9319008
									240	28	17.28	60	33	07.32	Sulphur Island Light	9,924.87	3.9967248
Serpent	46	10	28.016	865.01	83	41	04.898	104.98	17	19	40.01	197	18	14.54	Chippewa	8,548.71	3.9319008
									64	01	40.62	243	57	25.85	Kocruish	8,433.22	3.9259936
									119	28	06.92	299	24	11.48	Grande Point	8,101.01	3.9085393
									298	14	50.19	118	18	14.91	Sulphur Island Light	6,915.13	3.8398004
Sulphur Island Light	46	08	41.920	1,294.80	83	36	21.060	452.16	60	33	07.32	240	28	17.28	Chippewa	9,924.87	3.9967248
									88	17	44.74	268	10	05.87	Kocruish	13,679.62	4.1360741
									118	18	14.91	298	14	50.19	Serpent	6,915.13	3.8398004
Grande Point	46	12	36.957	1,141.4	83	46	33.906	726.95	3	52	20.53	183	52	03.06	Kocruish	7,696.69	3.8863038
									299	24	11.48	119	28	06.92	Serpent	8,101.01	3.9085393

TABLE NO. 3.—*Tertiary triangulation—Potagannissing Bay.*

Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*
Kocruish	90	29	20.19	5,152.19
238½	70	20	33.37	4,852.10
252	19	10	06.44	1,691.76
238½	13	03	56.47	1,530.27
254	130	26	07.26	5,152.19
252	36	29	56.27	4,026.29
Kocruish	72	54	41.83	4,026.29
238½	83	24	29.84	4,184.40
254	23	40	48.33	1,691.76
Kocruish	17	34	38.36	1,530.27
254	106	45	18.93	4,852.10
252	55	40	02.71	4,184.40
232	27	14	39.68	1,691.76
238½	31	26	56.25	1,928.10
Kocruish	121	18	24.07	3,157.45
232	28	11	22.56	1,900.26
238	128	17	12.62	3,157.45
238½	23	31	24.82	1,605.55
232	55	26	02.24	1,668.14
238	72	08	21.15	1,928.10
Kocruish	52	25	36.61	1,605.55
238	56	08	51.47	1,691.76
238½	54	58	21.07	1,668.14
Kocruish	68	52	47.46	1,900.26
236	23	28	18.35	1,605.55
238	130	16	42.07	3,075.32
232	26	14	59.59	1,782.87
295	79	11	35.81	3,075.32
236	41	35	48.11	2,078.52
232	59	12	36.07	2,689.55
295	39	50	08.11	1,782.87
236	65	04	06.46	2,523.82
238	75	05	45.43	2,689.55
295	39	21	27.70	1,605.55
238	55	10	56.64	2,078.52
232	85	27	35.66	2,523.82
295	53	12	40.93	2,763.85
301	51	11	54.73	2,689.55
236	75	35	24.34	3,342.57
301	75	28	45.74	3,535.15
Chippewa	49	11	12.88	2,763.85
236	55	20	01.38	3,003.53
295	25	07	28.09	3,003.53
301	126	40	40.47	5,673.40
Chippewa	28	11	51.44	3,342.57
295	28	05	12.84	3,535.15
Chippewa	20	59	21.44	2,689.55
236	130	55	25.72	5,673.40
301	89	20	54.92	3,379.28
303	62	42	59.05	3,003.53
Chippewa	27	56	06.01	1,583.19
301	164	49	39.63	4,311.83
303	9	39	28.07	2,763.86
236	5	30	52.30	1,583.19
303	53	03	30.98	3,535.15
Chippewa	77	07	20.03	4,311.83
236	49	49	08.99	3,379.28
303	34	15	29.46	958.06
301	77	16	17.86	1,660.12
299	68	28	12.68	1,583.19

TABLE NO. 3.—*Tertiary triangulation—Potagannissing Bay*—Continued.

Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*
305	50	20	56.32	1,660.12
303	64	07	51.92	1,940.10
299	65	31	11.76	1,962.33
305	14	49	05.43	958.06
301	31	11	30.13	1,940.10
299	133	59	24.44	2,696.14
305	35	31	50.89	1,563.19
303	98	23	21.38	2,696.14
301	46	04	47.73	1,962.33
305	58	05	58.76	3,923.85
299	97	04	51.04	4,586.65
Burnt Island	24	49	10.20	1,940.10
Bacon	62	11	42.14	4,586.65
305	57	43	11.76	4,383.94
Burnt Island	60	05	06.10	4,494.49
Bacon	44	05	00.06	3,923.85
299	51	00	43.64	4,383.94
Burnt Island	84	54	16.30	5,617.82
Bacon	18	06	42.08	1,940.10
305	115	49	10.52	5,617.82
299	46	04	07.40	4,494.49
Kocruish	31	44	58.38	2,212.97
254	52	30	30.86	3,336.83
250	95	44	30.76	4,184.49
Kocruish	104	39	41.24	4,165.30
238½	51	50	42.97	3,336.83
250	23	29	35.79	1,691.62
238½	31	33	53.03	2,212.97
254	76	11	12.00	4,105.30
250	72	14	54.97	4,626.29
240	20	27	51.34	1,530.27
254	109	33	52.90	4,124.39
252	49	58	15.76	3,351.46
246	103	58	48.35	4,124.39
240	65	25	29.66	3,865.10
252	10	35	41.99	781.44
246	80	48	13.86	3,351.46
240	85	53	21.00	3,396.36
254	13	18	25.14	781.44
246	23	10	34.49	1,530.27
254	96	15	27.76	3,865.10
252	60	33	57.75	3,396.36
293	60	02	43.80	2,078.52
295	74	06	22.50	2,307.25
232	45	50	53.70	1,721.25
293	34	30	48.45	1,355.08
232	70	44	55.45	2,257.87
230	74	44	16.10	2,307.25
293	94	33	32.25	2,945.93
295	49	49	09.30	2,257.87
230	35	37	18.45	1,721.25
295	24	17	13.20	1,855.08
232	116	35	49.15	2,945.93
230	39	06	57.65	2,078.52
305	58	06	00.19	3,923.85
299	97	04	52.99	4,586.65
Burnt Island	24	49	06.83	1,940.10
307	85	09	32.14	4,586.65
305	65	17	58.89	4,181.92
Burnt Island	29	32	28.96	2,269.55

TABLE NO. 3.—*Tertiary triangulation—Potagannissing Bay*—Continued.

Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*
307	59	16	20.53	8,923.87
299	66	22	03.68	4,181.92
Burnt Island	54	21	35,79	3,709.73
307	25	53	11.61	1,940.03
305	123	23	59.08	3,709.78
299	30	42	49.81	2,269.55
Serpent	14	03	52.80	2,189.34
Sulphur Island Light	36	04	21.02	5,304.57
262	129	51	46.18	6,915.29
Serpent	53	25	57.22	6,781.33
345	38	55	17.09	5,304.57
262	87	38	45.69	8,436.23
345	15	54	46.70	2,189.34
Sulphur Island Light	121	52	12.81	6,781.33
262	42	13	00.49	5,365.50
Harbor Island	81	39	23.45	5,617.46
Bacon	41	15	42.15	3,744.35
299	57	04	54.39	4,766.008
Harbor Island	48	55	59.63	8,556.09
299	78	31	09.93	4,622.29
341	52	32	50.44	3,744.35
Harbor Island	130	35	23.08	8,529.20
Bacon	24	18	05.79	4,622.29
341	25	06	31.13	4,766.008
Bacon	16	57	36.36	3,556.09
299	136	36	04.32	8,529.20
341	27	26	19.32	5,617.46
Harbor Island	30	39	10.66	2,540.20
341	81	15	49.06	4,924.56
337	68	05	00.28	4,622.29
Harbor Island	68	50	58.08	5,039.41
337	45	27	13.05	3,850.92
311	65	41	48.87	4,924.56
Harbor Island	99	30	08.74	6,486.32
341	35	50	31.26	3,850.92
311	44	39	20.01	4,622.29
341	45	25	17.80	5,039.41
337	113	32	13.33	6,486.32
311	21	02	28.86	2,540.20
Harbor Island	129	54	35.96	7,815.98
311	27	58	05.14	4,765.63
Bacon	22	12	18.90	3,850.92
Harbor Island	105	37	28.74	7,134.34
311	43	03	17.24	5,057.49
267	81	19	14.02	3,850.92
Harbor Island	24	17	07.22	2,085.87
267	69	59	42.20	4,765.63
Bacon	85	43	10.58	5,057.49
311	15	10	12.10	2,085.87
267	101	18	56.22	7,815.98
Bacon	63	30	51.68	7,134.34
Harbor Island	61	06	00.74	4,598.93
341	57	16	04.81	4,418.97
327	61	37	54.42	4,622.29
Harber Island	31	42	04.62	3,869.63
341	109	25	05.14	6,944.97
330	38	52	50.26	4,622.29
Harbor Island	29	23	56.12	3,779.54
339	35	01	30.78	4,418.97
327	115	34	33.08	6,944.97

TABLE NO. 3.—*Tertiary triangulation—Potagannissing Bay*—Continued.

Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*
327	53	56	38.66	3,869.63
341	52	09	00.30	3,779.54
339	73	54	21.04	4,596.93
248	75	33	01.5	4,184.46
Kooruish	62	35	57.0	3,836.30
254	41	51	01.5	2,882.96
248	29	28	03.7	1,928.18
232	47	21	11.4	2,882.98
Kooruish	103	10	44.9	3,816.21
244	59	40	37.03	1,926.10
232	63	51	12.24	2,005.11
Kooruish	56	28	10.73	1,861.86
244	68	27	47.5	3,336.83
Kooruish	77	33	28.0	3,563.04
250	33	58	44.5	2,064.80
232	27	11	55	861.43
Kooruish	63	49	22	1,790.62
242	88	58	43	1,928.18
232	82	37	52.97	2,204.47
238	51	07	26.77	1,730.49
242	46	14	40.26	1,606.55
297	91	05	50.5	6,404.06
Harbor Island	46	59	59.5	4,694.46
Chippewa	41	54	10	4,277.86
Bacon	50	54	48.03	4,277.35
Harbor Island	69	13	08.24	5,152.16
297	59	52	03.73	4,766.06
291½	55	24	39.73	2,257.87
298	99	24	23.54	2,705.77
230	25	10	57.73	1,167.01
291½	24	25	26.23	1,355.05
232	55	39	19.53	2,705.57
230	99	55	14.24	3,228.23
Grande Point	22	37	13.5	5,494.38
Serpent	122	49	53.6	12,003.17
260	34	33	52.9	8,101.01
Serpent	41	53	57.61	3,863.73
262	71	41	17.22	5,494.36
260	66	25	45.17	5,804.57
Bacon	19	02	06.77	1,927.24
309	126	14	20.26	4,766.01
Harbor Island	34	43	32.97	3,366.10
Bacon	77	43	55.06	5,061.67
269	66	24	51.97	4,766.01
Harbor Island	35	51	12.97	3,045.97
Bacon	29	51	31.73	2,943.87
279	53	42	32.53	4,766.01
Harbor Island	96	25	55.74	5,875.78
Harbor Island	32	30	46.23	2,268.57
281	114	09	43.24	3,850.93
311	33	19	30.53	2,318.80
Harbor Island	17	28	11.77	2,363.15
313	150	42	41.77	3,850.92
311	11	49	06.46	1,612.24
315	111	50	13.24	5,069.41
311	48	55	38.03	4,092.76
337	19	14	08.73	1,788.60
315	90	43	37.54	1,875.59
311	16	48	20.23	542.38
317	72	28	02.23	1,788.60

TABLE No. 3.—*Tertiary triangulation—Potagannissing Bay*—Continued.

Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*
315	83	14	05.54	2,074.29
311	87	51	54.23	1,282,14
319	58	54	00.23	1,788.60
331	49	23	02.78	2,540.20
337	97	19	16.24	3,819.08
341	33	17	41.03	1,836.98
333	49	59	47.7	2,540.20
337	74	54	39.5	3,201.82
341	55	05	32.8	2,719.50
327	25	20	05.47	1,044.21
331	15	34	55.77	655.50
329	139	04	58.76	1,508.29
327	21	59	34.27	2,874.24
331	143	24	19.27	3,779.54
339	14	36	06.46	1,508.29
Harbor Island	41	49	20	3,200.47
333	74	22	41	4,622.29
341	63	47	59	4,306.46
299	58	07	04.77	5,354.38
Harbor Island	85	27	15.97	6,285.84
335	36	25	39.26	3,744.35
Bacon	66	20	13.5	5,992.49
271	46	45	27	4,766.01
Harbor Island	66	54	19.5	6.018.24
Bacon	55	45	10.5	5,219.42
275	49	00	31.5	4,766.01
Harbor Island	75	14	18	6,105.78

TERTIARY TRIANGULATION IN THE DETOUR PASSAGE.

Stations.	Adjusted angles.			Sides.
Detour	28	28	56.65	1,713.62
237	55	51	12.35	2,973.85
235	95	39	51	3,575.78
264	26	13	09.02	1,713.62
237	125	05	05.25	3,173.92
235	28	41	45.73	1,862.39
266	30	48	15.02	1,862.39
237	17	13	41.23	1,077.11
264	131	58	03.75	2,708.99
266	52	08	13	1,935.37
239	26	03	51.3	1,077.11
264	101	47	55.7	2,399.65
266	14	47	31.47	1,357.95
241	26	49	06.76	2,399.65
239	138	23	21.77	3,532.01
Detour	17	03	29.70	1,551.18
268	120	25	28.39	4,559.77
Detour Light	42	31	01.91	3,573.65

TABLE No. 4.—*Coordinates of tertiary triangulation stations in Potagannissing Bay, referred to ⓐ Harbor Island, in meters.*

Station.	Located on—	North.	South.	East.	West.
		Meters.	*Meters.*	*Meters.*	*Meters.*
236	Maple Island	7,029.21		414.80	
238	North Seine Island	8,276.53			850.10
238½	Perrique Island	9,870.93		174.76	
240	Colville Island	10,575.69			1,140.31
242	Beef Island	9,856.94			2,398.65
244	St. Joseph Island	9,659.83			3,515.29
246	Hog Island	10,795.32			1,890.38
248	St. Joseph Island	11,754.68			3,644.12
250	....do	13,006.55			2,478.39
252	....do	14,657.19			1,732.38
254	Fox Island	13,851.33			431.37
260	Thessalon Island	16,069.40		10,924.15	
262	Gull Island	12,215.99		11,206.15	
269	Surveyors Island		12,439.33		4,457.91
271	Fairbanks Island		5,175.94		3,019.86
275	Picnic Island		4,841.81		1,949.16
279	Sam Island		2,943.63		37.73
281	Wreck Island		2,318.78	9.04	
291½	Burnt Island Reef	6,099.20			4,909.16
293	Burnt Island	6,260.46			3,813.21
295	....do	6,079.71			2,101.97
297	Wilson Island	4,157.40			1,008.31
299	Cedar Island	3,743.85			78.42
301	Choke Cherry Island	4,281.86		716.32	
303	Propeller Island	2,808.17		1,294.89	
305	Standerson Island	1,832.22			467.53
307	Saltonstall Island	924.62			2,487.04
309	Harbor Island Reef		891.67		1,708.56
311	Drummond Island		3,239.09	2,082.76	
313	Boulanger Island		1,555.31	424.65	
315	Rogg Island		1,519.52	1,590.60	
317	Fire Island		1,363.70	2,110.06	
319	La Point Island		1,314.39	2,856.23	
321	Grape Island		211.56	3,434.16	
323	Bald Island	130.22		2,243.94	
327	Drummond Island		1,428.20	4,181.81	
329	Bay Island		934.17	4,612.64	
331	James Island		788.97	5,646.71	
333	Ashman Island	31.90		4,306.34	
335	Rutland Island	532.67		5,327.70	
337	Peck Island	989.45		4,824.14	
339	Drummond Island	1,270.68		6,827.74	
341	....do	3,107.50		3,421.84	
343	....do	5,649.66		5,279.53	
345	....do	5,713.26		9,282.41	
237	....do		2,644.75	2,406.56	
239	....do		3,618.92	2,587.56	
241	Bellevue Island		4,175.22	3,826.32	
264	Upper Peninsula, Mich		3,828.27	674.13	
266	....do		4,337.59	298.04	
268	Island		3,395.23		1,115.06

DISCHARGE MEASUREMENTS IN ST. MARYS RIVER.

B.—REPORT OF MR. E. E. HASKELL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1897.

SIR: I have the honor to make the following report upon the discharge measurements made in the St. Marys River at Sault Ste. Marie, Mich., during February and March, 1896:

In my last annual report, page 4027, part 6, of the report of the Chief of Engineers for 1896, I gave a brief description of discharge measurements made in St. Marys River during the winter of 1895-96. In the present report we propose to discuss only those observations that were described as having been made on the Spry's Dock section. So few observations were made on the Kemp's Dock section that they have not been reduced, and we do not feel that we have, as yet, all of the data required for a thorough discussion of the observations made from the International Bridge. A few more observations must be made for determining the coefficient to reduce surface velocity measured to the mean of the vertical curve for several of the bridge spans.

The St. Marys River from its source, Lake Superior, to its mouth, where it empties into Lake Huron, measured along the main channel line, is 62 miles long. It is a crooked stream, very variable in width, and is divided at several points by large islands. Beginning at its head it is 4 miles wide. It retains this width for about 5 miles, where it begins to grow narrower, and a distance of 4 miles farther, has reached a width of about half a mile; then it abruptly widens to about 2 miles and retains this width until the head of the St. Marys Rapids are reached, a distance of 14 miles from the starting point. From the best data available, the fall of the river to the head of the rapids is 0.41 of a foot.

The St. Marys Rapids are about 1 mile long and half a mile wide, and the mean fall in them—from twenty-five years' observations, 1871 to 1895, inclusive—is 17.68 feet. From the foot of the rapids the river is nearly straight for a distance of 2 miles and has an average width of about three-fourths of a mile, the fall being about 0.2 of a foot. It is in the middle of this reach that the discharge section was located.

At the foot of this straight reach the river is divided by Sugar Island into two main channels, known as the Hay Lake and Lake George routes. The present steamboat channel is by the way of Hay Lake; by this route the Little Rapids, which aggregate about one-fourth of a mile in width, cover the first 1¼ miles, and in this distance there is a fall of about 0.75 of a foot. Hay Lake begins at the foot of the Little Rapids, and, measured along the sailing line, is approximately 11 miles long, 2 miles wide, and has a fall of 0.1 of a foot. At the foot of Hay Lake is Neebish Island which helps to form two outlets, the West and the Middle Neebish Rapids. The main channel is by the Middle Neebish Rapids, which are approximately 2 miles long, one-half mile wide, and have a fall of 0.8 of a foot. About a mile below the foot of these rapids, at the foot of Sugar Island, the Lake George branch of the river again joins the Hay Lake branch, after having traversed 26 miles, 16 of which may be called "river" and the remaining 10 "lake," and having divided its waters on the head of St. Joseph Island, a part of them going to Lake Huron by way of the Collingwood channel.

From the foot of Sugar Island the main channel passes through Little Mud Lake, 3 miles long and three-fourths of a mile wide, and through the Sailors Encampment reach of the river, 2 miles long and one-fourth of a mile wide, and then empties into Mud Lake. In the 5 miles from the foot of Sugar Island to the head of Mud Lake the fall is about 0.6 of a foot.

This route by way of the West Neebish Rapids, from the head of Neebish Island to Mud Lake, is about 7 miles, the first 3 of which may be called a part of Hay Lake, and the remaining 4 rapids and river. The rapids themselves are about 1 mile long and three-eighths of a mile wide. The fall by this route is, of course, the same as that from Hay Lake to Mud Lake by way of the Middle Neebish and Sailors Encampment.

From the head of Mud Lake to Lake Huron is 24 miles. This reach of the river is very broad the greater part of its length and has two outlets, one by way of Potagannissing Bay and the other by the main channel. It is so large a stream, in relation to the volume of water it has to carry, that the fall is but slight; a fair estimate would probably be 0.2 of a foot.

From the head of the river to Lake Huron, as stated above, is 62 miles, and in this distance the river has fallen 20.75 feet, which represents the difference in elevation between the level of Lake Huron and that of Lake Superior. The results of twenty-five years' observations, from 1871 to 1895 inclusive, show the mean level of Lake Superior to be 601.94, and of Lake Huron to be 581.19, referred to mean tide at New York.

The stream is one that would be called permanent in its character, its banks and bed being for the most part rocky. The bed is very irregular from the many shoals that are to be found along it. In consequence of this the flow of water is also very irregular. In the rapids and restricted portions the current is strong, while in many stretches, such as the lakes, it is almost inappreciable.

THE DISCHARGE SECTION.

The discharge section, located as stated above in the reach of river extending from the foot of the St. Marys Rapids to the head of the Little Rapids, is probably as good a one as can be chosen at any point along the river. All of the flow coming out of Lake Superior has to pass this point. The location of this section is shown on Pl. I, which is a map of the river from the head of the St. Marys Rapids to near the head of Little Rapids, a distance of about 3 miles. On this map can be seen also the location of the gauges used. The section began at the foot of Spry's Dock, on the American side of the river, and ended against Plummer's Dock, on the Canadian side of the river. The amount of water passing behind or underneath these docks is quite inappreciable. The water width of the section is 2,483 feet. The river was frozen over at the time of making the observations, and the section was sounded, and all of the current observations made, through the ice. The section was lined out with a transit and a small stake set every 10 feet, starting from the dock on the American side. An ice auger was then used to bore a hole at each stake, and through this a sounding was made with a sounding reel, using a very heavy lead attached to a No. 18 steel wire. From these soundings the discharge section has been platted and will be found on Pl. I. As great care was taken in laying out the section, marking the distances along it, and in making the soundings, it is not probable that an error as great as 1 per cent exists in the area of the section thus determined.

WATER GAUGES.

In making the observations four water gauges were used, located as follows: One at the head of the canal, one on the south abutment of the International Bridge, one on the northeast pier of the canal, at the foot of the Rapids, and one on the discharge section on the American side. These locations may be seen on the map, Pl. I. They were all staff gauges and marked to read, directly, the elevation of the water surface above mean tide at New York.

The gauge at the head of the canal is the one that has been read daily at noon since January 1, 1871. This gauge gives the level of Lake Superior, less the fall of the river from the lake to the gauge, which, as stated above, is 0.41 of a foot. The gauge on the south abutment of the International Bridge is the one used as a section gauge for the observations made from the bridge. This gauge was read every fifteen minutes, simultaneously with the gauge at the head of the canal, for three days. From these observations the mean fall from the head of the canal to the Bridge was found to be 0.20 of a foot.

The gauge on the northeast pier of the canal is practically at the foot of the Rapids. It was used for the purpose of determining the fall between the foot of the Rapids and the Spry's Dock discharge section. The gauge was read every fifteen minutes, simultaneously with the section gauge, for a period of six days, and the observations give a mean fall of 0.12 of a foot. The section gauge was located directly at the end of the discharge section on the American side. This gauge, as well as the one at the International Bridge, was read every fifteen minutes on all days when discharge measurements were in progress. The gauge on the International Bridge was also read simultaneously with the section gauge.

CURRENT METER USED.

The current meter used was a Haskell, Form E. They belong to the screw or propeller wheel class and are electric recording. They are 16 inches long, have wheels 4 inches in diameter, and weigh 2½ pounds. With their low-pitch wheel they will register velocities as low as 0.35 of a foot per second.

HYDROMETRIC PENDULUM USED.

On the discharge section were three meter stations against the left bank, at which the velocity was too low to be recorded with the meter. After considering the question of how to obtain a measure of the velocity at these stations, we decided to try a hydrometric pendulum. Accordingly, a ball 4 inches in diameter was turned from a block of hard wood and sufficient lead was inserted, as a plug, to render the ball just heavy enough to sink. This ball, with a very fine braided silk cord attached to it, constituted the pendulum. A square board was next made from 1-inch pine large enough to permit striking, from a point near one corner as center, with a 2-foot radius, a quadrant of a circle. Beginning with a radius drawn parallel to one edge of the board, this arc was graduated to half degrees. At the extremity of this arc, in the upper right-hand corner, a plate level from a transit was adjusted to a position in the plane of the board at right angles to the zero radius. Directly underneath this level, on the lower edge of the board, was a screw some 4 inches in length with a spherical head, working in a nut to form a leveling screw. A reel was attached to the side of the board and on this was wound the silk cord of the pendulum, after having passed over a small screw set at the center of the circle. In making observations it was easy enough to estimate the tenth of a degree.

RATING OF METER.

As stated in my last year's report, a few obervations were made for rating the meter in November, previous to making the discharge measurements that were taken at the International Bridge. The meter was thoroughly rated on completing the discharge measurements on the Spry's Dock section in March, and it is this rating that has been used in reducing all velocities measured. A description of this rating will be given together with the reduction of the rating observations.

To make a rating a slit about 8 inches wide and 200 feet long was sawed in the ice, in the canal just above the movable dam. The movable dam was closed at the time and there was no current through the canal. A large sled was selected that would considerably more than span the slit in the ice. Through a hole in the center of the sled was placed a ¾-inch gas pipe which was supported in a vertical position by a frame work attached to the sled. This piece of gas pipe was long enough to pass about 2 feet below the bottom of the ice, and to it the meter was attached in such a manner that it was free to assume the direction in which it was moving. To keep the sled from sliding sideways pieces of 2 by 4 scantling were spiked to the ice on each side of the slit, forming rails between which the runners were confined. The base was 150 feet long, leaving 25 feet at each end for space for starting and stopping the sled in making an observation. The battery, register, and observer occupied a position on the sled, which, with the meter attached, was hauled forward and backward over the course by two men, obtaining the observations which appear in the rating below, Table 1.

The method given above can hardly be recommended unless the ice is perfectly smooth. Otherwise there is a continuous trembling of the meter from the jar caused to the sled, and poor observations result. Some difficulty from this source was experienced in making the present rating.

Previous to reducing the observations by the rigid method of least squares for the purpose of finding the rating equation, all the observations made were platted on cross-section paper, the time required to traverse the base and the number of revolutions made in that time being used as abscissas and ordinates, respectively. An approximate curve representing a majority of the observations was then drawn on the sheet. Some observations which fell so far from this curve as to indicate that they were greatly in error were rejected. From each of the remaining observations an observation equation of the form $y=a+bx+cx^2$ was written, and from them the equation of the most probable curve was deduced by the method of least squares. This equation was found to be $y=0.3785+0.8132x+0.0834x^2$, where x=revolutions per second, giving y in feet per second. The probable error of a single observation is +0.0109.

All of the velocities measured on the Spry's Dock section fell between zero and 2.2 feet. The rating observations, as seen from the table, are made to cover practically the same limits.

TABLE NO. 1.—*Meter rating—Meter E, low-pitch wheel.*

Number of revolutions.	Time in seconds.	y feet per second.	x revolutions per second.	x^2.	x^3.	x^4.	xy.	x^2y.	Computed y.	v.	vv.
27	329.5	0.455	.082	.007	.001	.000	.037	.003	.446	+.009	.000081
45	290	.517	.155	.024	.004	.001	.080	.012	.506	+.011	.000121
46	290	.517	.159	.025	.004	.001	.082	.013	.509	+.008	.000064
45	289.5	.518	.155	.024	.004	.001	.081	.012	.506	+.012	.000144
59	273.25	.549	.216	.047	.010	.002	.119	.026	.558	—.009	.000081
60	266	.564	.226	.051	.011	.003	.127	.029	.566	—.002	.000004
65	248.5	.604	.268	.072	.019	.005	.162	.043	.602	+.002	.000004
70	238.75	.628	.293	.086	.025	.007	.184	.054	.623	+.005	.000025
72	237.25	.632	.303	.092	.028	.008	.192	.058	.632	.000	.000000
78	231.25	.649	.337	.114	.038	.013	.219	.074	.662	—.013	.000169
75	228.75	.656	.328	.107	.035	.012	.215	.070	.654	+.002	.000004
78	226.5	.662	.344	.119	.041	.014	.228	.079	.668	—.006	.000036
75	220	.682	.341	.116	.040	.014	.233	.079	.665	+.017	.000289
85	208.25	.720	.408	.167	.068	.028	.294	.120	.724	—.004	.000016
83	205.25	.731	.404	.164	.066	.027	.296	.120	.720	+.011	.000121
89	201	.746	.443	.196	.087	.038	.330	.147	.754	—.008	.000064
92	194.75	.770	.472	.223	.105	.050	.364	.172	.781	—.011	.000121
95	186	.806	.511	.261	.133	.068	.412	.210	.815	—.009	.000081
98	180.25	.832	.544	.296	.161	.087	.452	.246	.845	—.013	.000169
99	178	.843	.556	.309	.172	.096	.469	.261	.856	—.013	.000169
101	166	.904	.608	.370	.225	.137	.550	.334	.903	+.001	.000001
106	163.25	.919	.649	.422	.274	.178	.597	.387	.941	—.022	.000484
106	160.50	.935	.660	.436	.288	.190	.617	.408	.951	—.016	.000256
106	156	.962	.680	.462	.314	.213	.653	.444	.970	—.008	.000064
110	131	1.145	.840	.705	.592	.497	.961	.807	1.120	+.025	.000625
113	130	1.154	.869	.756	.657	.571	1.003	.872	1.147	+.007	.000049
116	116.25	1.290	.998	.996	.994	.991	1.288	1.285	1.272	+.018	.000324
118	116	1.293	1.017	1.035	1.053	1.071	1.315	1.338	1.291	+.002	.000004
119	111	1.351	1.072	1.149	1.232	1.321	1.449	1.553	1.346	+.005	.000025
124	99	1.515	1.252	1.569	1.965	2.461	1.898	2.377	1.527	—.012	.000144
123	92	1.593	1.337	1.788	2.390	3.195	2.130	2.848	1.614	—.021	.000441
122	90.5	1.657	1.348	1.817	2.450	3.303	2.234	3.012	1.626	+.031	.000961
122	87	1.724	1.402	1.966	2.758	3.867	2.418	3.390	1.683	+.041	.001681
129	71	2.113	1.817	3.301	5.998	10.897	3.838	6.974	2.131	—.018	.000324
130	65	2.308	2.000	4.000	8.000	16.000	4.615	9.232	2.338	—.030	.000900
127	64	2.344	1.984	3.938	7.810	15.494	4.651	9.231	2.319	+.025	.000625
		36.288	25.078	27.210	38.052	60.861	34.793	46.320	....	....	.008671

Normal equations.

$$\begin{array}{lr}
\text{I} & -36\,a + 25.078\,b + 27.210\,c - 36.288 = 0 \\
\text{II} & -25.078\,a + 27.210\,b + 38.052\,c - 34.793 = 0 \\
\text{III} & -27.210\,a + 38.052\,b + 60.861\,c - 46.320 = 0
\end{array}$$

$$e = \sqrt{\frac{.008671}{33}}$$

$$r = .6745\sqrt{\frac{.008671}{33}} = 0.01093$$

The solution of the normal equations gives $y = 0.37846 + 0.81318\,x + 0.08345\,x^2$, whence the columns "computed y," "v," "vv."

OBSERVATIONS FOR DISCHARGE.

The meter stations, or points at which velocity observations were made, were located 100 feet apart on the cross section; the total area of the cross section was thus divided into partial areas, each of which was 100 feet in length. At the time the cross section was sounded, stakes to mark these meter stations were left in the ice, the first stake, to mark station No. 1, being placed 50 feet from the south end of the cross section, the second stake 100 feet farther north, and so on. The observations made at a given meter station were applied to that partial area of which it occupied the middle point. At each meter station a hole was cut in the ice about 1½ by 2½ feet, and these holes were cleared of ice each morning before making the observations.

A light house about 6 feet square, built of half-inch lumber and covered with roofing paper, was used as a protection for the meter and the operators. This house was mounted on two wide runners so that it might be moved from station to station. At first it was moved by hand, but in soft weather this method proved to be both slow and laborious, and in the later observations a horse was utilized for this purpose.

A reel with a drum about 11 inches in diameter and 6 inches long was supported, about 2 feet from the floor, by a framework from the roof, and the meter cable was wound upon it. On the rear end of the drum two rings, about three-quarters of an inch wide, cut from sheet brass, were fastened concentrically and insulated from each other. The insulated wire of the cable was connected to one of these rings and the wires of the armor of the cable to the other. Two brass springs were arranged on the frame of the reel so that each pressed against one of the rings on the drum. From each spring led an insulated wire for the circuit through register and battery. The reel was provided with a crank, ratchet wheel, and pawl, the ratchet being so cut that each tooth corresponded to a change in the depth of the meter of one-tenth of a foot.

A hole was cut in the floor of the house near the front and directly under the reel. This hole was about 9 by 24 inches in size and allowed the meter to pass freely up and down. A cover was provided for this hole that it might be covered during the time the meter was not in use.

A fine wire, wound upon the axis of the cable reel, led over a pulley, and was weighted at its free end to keep it taut. A pointer was clamped upon the wire for an index to a vertical gauge placed on the side of the house and graduated to read, directly in feet, the depth of the center of the meter below the water surface. The gauge had a small vertical motion and could be clamped at any desired point. Each time the meter was lowered the gauge was checked, or set so that the pointer indicated the zero of the gauge when the center of the meter was at the water surface. Variations in the thickness of the ice and snow above the water surface rendered occasional changes in the gauge necessary. A small heating stove was placed in one corner of the house, and in another corner a shelf for the recorder to write upon.

The method pursued was to make from one to three complete observations for discharge each day and then occupy the rest of the day in making observations for velocities in the verticals. Each complete observation for discharge was made as rapidly as possible, passing from station to station without delay until all of them had been occupied. A complete measurement usually required about one hour.

Some preliminary observations in the verticals indicated that the maximum velocity would be found at a point about four-tenths of the depth from surface to bottom, and since it was known that the point giving the mean velocity would not be at the usual depth, on account of the disturbing effect of the ice, it was decided to observe the velocities at four-tenths depth and apply the proper coefficient to reduce the result to mean velocity when this coefficient should have been determined.

The method of making an observation for discharge was, in detail, as follows: The meter having been attached to the cable and the electrical connections with the register made, the meter was lowered to the water surface and the gauge set so that the pointer indicated zero. The meter was then lowered by the attendant to the four-tenths-depth point, the register read and recorded, and the circuit completed. At the end of one minute the circuit was broken and the register again read and recorded. Meantime the attendant had measured the depth of the bottom of the ice below the surface of the water and this depth had been recorded. The meter was then reeled in and the signal to go ahead given to the man leading the horse.

The house was drawn to the next station and placed so that the hole in the floor came directly over the hole in the ice, when another observation could be proceeded with.

In making observations in the vertical, the gauge indicating the depth of the water was checked as in the other case, and the meter lowered to the bottom of the river. The meter was then hauled up until the lead weight just cleared the bottom; the gauge showing the depth of the meter was read and recorded and an observation of the velocity made. The first observation was thus made with the meter about one foot above the bottom. The last observation was made with the meter about one foot below the under surface of the ice. The distance between these two points was divided into ten parts, an observation being made at each point so determined, proceeding from the bottom upward.

At the three meter stations nearest the north shore there was not sufficient current to turn the wheel of the meter, though a reading could occasionally be obtained at Station 23, the first of the three. For these stations the hydrometric pendulum described above was used to determine the velocity. The ball of the pendulum was lowered to the four-tenths-depth point and the board bearing the graduated quadrant was placed in a vertical plane parallel to the direction of the current and the zero line of the quadrant was made vertical by the level and tangent screw. The ball would now swing backward and forward through a small arc with the uneven impulse of the current, and a reading was taken at the two extremities of each swing until twenty readings had been obtained.

REDUCTION OF OBSERVATIONS.

As is stated above, the cross section was divided into 25 partial areas, each of which was 100 feet long (except the last section, which was 83 feet long). Each partial area was treated separately to obtain the amount of water passing, and the sum of these partial discharges gave the total discharge for that set of observations. Fifty-four complete observations for discharge were obtained, and 10 sets of observations in the vertical were taken for each meter station from 1 to 22, inclusive.

For the purpose of determining the relation of the velocity at four-tenths depth to the mean velocity, the latter was obtained from the observations in the vertical, the mean of the 10 readings at each of the 11 points in the vertical being used. In obtaining this mean the readings at the bottom and top points were given the same weight as the intermediate readings, since the first observation was made at a point about 1 foot above the bottom of the river and the last reading at about the same distance below the under surface of the ice. Thus, the ratio of the mean velocity to the velocity at four-tenths depth, taken from the 10 sets of observations in the vertical, gave, for each station, a separate coefficient to reduce observed to mean velocity in the discharge observations. Had the coefficient obtained from the mean vertical curve of 22 stations been used for reducing observed to mean velocity at all stations, the resulting error in the total discharge would have been very small, not exceeding six-tenths of 1 per cent in an extreme case.

The partial areas were computed with reference to a datum plane 580 feet above mean tide at New York, and corrections were made to these areas for each measurement, according to the height of the water surface and the thickness of the ice. The product of the mean velocity and the corrected area gave the partial discharge for each partial area, and the sum of these partial discharges gave the total discharge for one measurement.

Table 2 gives the table of reduction for measurement No. 36, made March 5, 1896, and will require but little explanation. Since the discharge through areas 23 to 25, inclusive, was so small, and since more time was required to measure the velocity in these sections, it was considered that they would have an undue weight in fixing the mean gauge height if treated the same as the other sections. It was therefore decided to correct the results obtained at these stations to the mean gauge reading during the time of making the observations at the other 22 stations. These corrections were always quite small, and those for this measurement are indicated in the table.

The hydrometric pendulum was used for measuring velocities that were too low to be recorded by the meter. Theoretically, the velocity varies as the square root of the tangent of the angle which the pendulum cord makes with the vertical, or, $v = k\sqrt{\tan\theta}$, where v = the velocity at the point where the ball is, θ is the angle of the pendulum cord with the vertical, and k is a constant to be determined by experiment. To determine k a series of rating observations was made by lowering the ball and the meter side by side and taking simultaneous observations with the two instruments. The meter gave v and the pendulum gave θ, and k was therefore determined by the equation $k = \frac{v}{\sqrt{\tan\theta}}$. The values of k thus obtained varied considerably one from another. It was found that k varied with the depth of the ball below the surface, a smaller value being obtained when the ball was at a greater depth. This was accounted for by the fact that when the ball was at a great depth the action of the current upon the cord made θ too large, a greater area being subjected to the impulse. The depths at Stations 23 to 25 were moderate, so the rating observations made at greater depths were rejected and a mean value of k obtained from the remaining observations. In several cases a meter reading was obtained at Station 23 and then the ball was lowered and an observation taken with the pendulum. By using the value of k, obtained as stated above, it was found that the velocity given by the pendulum was considerably higher than that given by the meter. Since in rating the meter several observations had been obtained at very low velocities which agreed well with the rating equation adopted, it was considered that the meter readings were much more reliable for any velocity which the meter would record than were the results of the pendulum observations. It was therefore concluded to adopt for k a variable value which would fit fairly well the values obtained from the rating observations at comparatively high velocities and diminish with decreasing velocities, so as to make the result deduced from the pendulum observations at Station 23 accord with the result given by the meter at this station at about the same time. The value of k expressed by the equation $k = 1.45 + 1.38\ v$, appeared to satisfy this condition and was used in the reduction. In using this equation a value of v was at first assumed and the value of k given by the equation was used in the formula $v = k \sqrt{\tan \theta}$. A second approximation was then made, using a new value of k given by the first approximate value of v.

TABLE NO. 2.—*Specimen computation table—measurement No. 36—taken March 5, 1896.*

Station.	Time of day.	Elevation of water surface above mean tide at New York.		Ice below water surface.	Corrections to area.			Area of section.		Velocity.			Discharge per second.
		At Sprys Dock.	At International Bridge.		For gauge.	For ice.	Total.	Datum.	Water.	Observed at 0.4 depth, feet per second.	Coefficient to reduce to mean.	Mean, per second.	
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*
	A. M.	*Feet.*	*Feet.*	*Feet.*	*Sq. feet.*	*Sq. feet.*	*Sq. feet.*	*Sq. feet.*	*Sq. feet.*	*Feet.*		*Feet.*	*Cub. feet.*
1	8.45	582.33	601.12	1.6	+233	−160	+ 73	2,160	2,233	1.01	.926	.94	2,099
2	8.48	.34	.12	1.3	+234	−130	+104	2,870	2,974	1.14	.922	1.05	3,123
3	8.50	.34	.12	1.3	+234	−130	+104	3,120	3,224	.99	.904	.89	2,870
4	8.53	.35	.12	1.3	+235	−130	+105	2,968	3,073	1.30	.919	1.19	3,658
5	8.55	.35	.12	1.2	+235	−120	+115	2,624	2,739	1.52	.886	1.35	3,698
6	8.58	.36	.12	1.2	+236	−120	+116	1,835	1,951	1.46	.867	1.27	2,478
7	9.00	.36	.12	1.2	+236	−120	+116	1,755	1,871	1.56	.909	1.42	2,657
8	9.02	.36	.11	1.3	+236	−130	+106	2,255	2,361	1.47	.932	1.37	3,235
9	9.04	.36	.11	1.3	+236	−130	+106	3,202	3,308	1.40	.906	1.27	4,201
10	9.07	.36	.10	1.2	+236	−120	+116	4,011	4,127	1.14	.908	1.04	4,292
11	9.10	.37	.09	1.3	+237	−130	+107	3,908	4,015	1.07	.860	.92	3,694
12	9.12	.37	.08	1.3	+237	−130	+107	3,496	3,603	1.11	.845	.94	3,387
13	9.16	.37	.07	1.3	+237	−130	+107	2,594	2,701	1.22	.766	.93	2,512
14	9.18	.37	.06	1.2	+237	−120	+117	2,483	2,600	1.35	.760	1.03	2,678
15	9.20	.37	.05	1.3	+237	−130	+107	3,109	3,216	1.31	.857	1.12	3,602
16	9.23	.37	.05	1.4	+237	−140	+ 97	2,906	3,003	1.28	.747	.96	2,883
17	9.25	.37	.04	1.3	+237	−130	+107	2,762	2,869	1.07	.902	.97	2,783
18	9.27	.37	.04	1.3	+237	−130	+107	2,724	2,831	.66	.883	.58	1,642
19	9.30	.37	.03	1.3	+237	−130	+107	2,550	2,657	.81	.841	.68	1,808
20	9.32	.37	.03	1.2	+237	−120	+117	2,331	2,448	.99	.858	.85	2,081
21	9.35	.36	.02	1.2	+236	−120	+116	2,118	2,234	.60	.851	.51	1,140
22	9.37	.36	.02	1.1	+236	−110	+126	2,021	2,147	.54	.858	.46	989
23	9.43	.35	601.00	1.5	+235	−150	+ 85	1,899	1,979	.35*a*	.86	.31*b*	614
24	9.47	.35	600.98	1.3	+235	−130	+105	1,713	1,818	.305*a*	.86	.28*b*	510
25	9.50	.35	.97	1.5	+195	−124	+ 71	1,216	1,287	.05*a*	.86	.05*b*	64
Means for first 22 stations		582.360	601.080			Sums of 25 stations		64,630	67,269				62,698

a As observed.

b Corrected to mean gage for stations 1 to 22.

There is, perhaps, no warrant in the theoretical consideration of the pendulum for adopting a variable value for *k;* but since the rating observations were of necessity made in a higher velocity than that in which the pendulum was to be used, and since to adopt the value given by these observations would give for the low velocities results which were not in accord with the results given by the meter, it appeared to be the best that could be done. It must be said, however, that the results obtained from the pendulum were far from satisfactory and can only be considered as an approximation. The combined discharge, as computed, for sections 23, 24, and 25 varies from 1¼ to 2¼ per cent of the total discharge, so that the error in determining the velocities at these stations, even if quite large, can have but a trifling effect on the result obtained for the total discharge of the river, certainly not affecting the final result as much as 1 per cent.

RESULTS.

On Pl. II have been plotted the vertical curves of velocities for meter Stations 1 to 22 inclusive, together with the mean vertical curve. As has been explained, the vertical curve for each meter station is the mean of 10 independently observed curves at that station, while the mean vertical curve is made up of 22 times 10 or 220 independently observed curves.

The 22 vertical curves are very similar in form. Those irregularities that appear are undoubtedly due to the very uneven condition of the bed of the river, and to the varying directions given to the current in consequence.

The following constants have been derived from the mean vertical curve of velocities:

The mean velocity $V_m = 1.087$ feet per second. In consequence of the river being frozen over and the ice retarding the surface flow, there are two depths at which this mean velocity was found, namely, 0.067 D and 0.753 D. The maximum velocity was 1.250 feet per second, and was found at approximately 0.4 D.

The velocity at mid-depth, $V_{\frac{1}{2}D} = 1.232$ feet per second.

$$\frac{V_m}{V_{\frac{1}{2}D}} = \frac{1.087}{1.232} = 0.882.$$

The friction caused by the ice was found to be 0.309, or practically 31 per cent of that caused by the bottom.

On Pl. III have been plotted the transverse curves of velocities for each tenth of depth, together with the mean derived from the 11 transverse curves. The velocities used in these curves are those used in the vertical curves. The surface transverse curve is made up of the 10 surface velocities, measured at each meter station, for Stations 1 to 22, inclusive. The transverse curves for the other depths are made up in the same manner. It will be noticed that the transverse curves for the depths from surface to six-tenths, inclusive, are very similar in form, while those from the seven-tenths depth to the bottom are more or less irregular. These irregularities are the same as those noticed in the vertical curves, and of course come from the same cause. The mean transverse curve is derived from the 11 transverse curves for the tenths of depth. From the mean transverse curve we observe that the river is not flowing forward as a single stream, but three separate streams, as is shown by the three maximum points on it.

An attempt was made to adjust an equation representing some one of the conic sections to the mean vertical curve of velocities, but without success, when the axis of the curve was considered as parallel to the direction of the current. An ellipse with an inclined axis, however, does fit the observations fairly well. But even if the curve of velocities in the vertical in a stream of uniform regimen may, as has been supposed, be represented by a conic section, it is not strange that this law is not sustained in the present instance when we consider the irregularities in several of the vertical curves, caused by the uneven bed of the river and the consequent varying directions of the current.

From the description of the river already given it will be seen that the conditions existing in the vicinity of the discharge section may be compared to the case of a reservoir discharging over a weir into a conduit, and thence into a second reservoir below. A rise of the water surface in the upper reservoir will result in an immediate increase in the rate of discharge and this will tend to raise, somewhat, the level of the water in the upper end of the conduit; but a rise in the level of the lower reservoir would also cause the water to rise in the upper end of the conduit without in the least affecting the discharge. Likewise the elevation of the water surface at the discharge section is dependent upon the level of Lake Huron and the slope of the lower river. The latter is influenced by the former, and by the amount of water passing, as well as by the direction and force of the wind. Thus the peculiar conditions existing at the discharge section, due to its location just below the St. Marys Rapids, renders the discharge only indirectly dependent upon the elevation of the water surface at the section, but a direct function of the water level of Lake Superior. In endeavoring to obtain a relation between gauge height and discharge it was therefore necessary to use the gauge read at the head of the rapids, which will be called the bridge gauge. In order to make this course entirely logical, however, it is necessary to correct the rate of discharge found at the Sprys Dock section to correspond to the rate at the bridge. Since the two sections are so near together, and no side streams enter the river between them, the only correction required is that due to pondage above the Sprys Dock section and below the rapids. It is evident that if the water level below the rapids is rising at the time of making a discharge observation a portion of the water passing the bridge is required to make this rise, and the rate of discharge as measured at the section will be lower than at the bridge. The area of the water surface below the rapids and above the section is about 0.728 square mile, and therefore a rise of one hundredth of a foot per hour corresponds to a rate of pondage of about 57 cubic feet per second. If the water surface below the rapids is falling at the time of making an observation, then the rate of discharge at the section is higher than that at the bridge by this amount. In the case of measurement number 36 it is seen that this pondage amounts to about 230 cubic feet per second and the discharge referred to the bridge is 62,930 cubic feet per second while at the section it was measured as 62,700 cubic feet per second. The largest correction of this kind amounts to 620 cubic feet per second for measurement number 53. With these corrected discharges, we may consider that we are dealing directly with the discharge at the bridge, and refer it to the bridge gauge.

Table 3 contains the results of the discharge measurements. It hardly needs any explanation. Column *j* gives the discharges corrected for pondage as explained above. Results in column *i*, mean velocities, are obtained by dividing the discharge by the area of the water cross section. Since the rate of discharge varies with the height of the water surface at the bridge, while the area of the water cross section varies as the thickness of the ice and the height of the water surface at the section, the mean velocities obtained as above follow neither the height of the water surface at the bridge nor that at the section. Column *k* gives the direction and the force of the wind as observed by the United States Weather Bureau, at their station at Sault Ste. Marie, during the time the measurement was in progress.

TABLE NO. 3.—*Discharge of St. Marys River.*

Number of measurement.	Date of observation.	Mean elevation of water surface above mean tide at New York.		River rising + River falling — during observations.		Mean depth of bottom of ice below water surface during observations.	Area of water, cross section.	Mean velocity, per second.	Discharge, per second.	Direction and force of wind (miles per hour).
		At section.	At bridge.	At section, per hour.	At bridge, per hour.					
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
	1896.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Sq. feet.*	*Feet.*	*Cub. feet.*	
25	Feb. 25	582.459	600.683	.00	—.18	1.27	67,590	.895	60,470	SE., 15.
37	Mar. 5	.320	.862	—.03	—.12	1.30	67,180	.894	60,080	SE., 9.
39	Mar. 6	.257	.900	+.02	+.16	1.33	66,930	.913	61,130	SE., 15.
38	Mar. 5	.276	.903	+.02	+.12	1.30	67,070	.918	61,570	SE., 17.
14	Feb. 17	.543	600.925	—.01	+.02	1.17	68,020	.888	60,420	SE., 13.
24	Feb. 25	.610	601.035	+.04	+.06	1.27	67,970	.958	65,110	SE., 5.
36	Mar. 5	.360	.080	+.04	—.13	1.30	67,270	.935	62,930	E., 4.
13	Feb. 17	.588	.082	+.04	+.12	1.17	68,140	.953	64,920	SE., 7 to 10.
42	Mar. 10	.532	.095	—.02	—.11	1.35	67,560	.993	67,110	SE., 7.
41	Mar. 9	.563	.096	.00	—.03	1.32	67,730	.995	67,390	NE., 3.
53	Mar. 23	.354	.102	+.11	+.22	1.27	67,330	.975	65,620	E., 3; W., 3; variable.
26	Feb. 27	.634	.102	+.03	.00	1.30	67,940	.973	66,090	SE., 14.
48	Mar. 13	.440	.109	+.01	+.07	1.32	67,410	.980	66,050	E., 3; SE., 3.
7	Feb. 12	.876	.110	—.03	—.02	1.05	69,170	.943	65,210	E., 3.
44	Mar. 11	.481	.116	.00	+.05	1.34	67,470	.956	64,470	S., 2; SW., 3.
43	Mar. 10	.520	.130	+.04	+.13	1.37	67,490	1.023	69,070	W., 3; variable.
35	Mar. 4	.503	.143	+.04	+.23	1.26	67,730	.977	66,150	SE., 1.
52	Mar. 16	.412	.150	+.05	+.09	1.36	67,250	.987	66,350	SE., 3; E., 6.
2	Feb. 10	.650	.152	.00	—.07	1.00	68,720	.972	66.820	SE., 5,
50	Mar. 14	.470	.158	+.05	+.13	1.36	67,400	.967	65,150	NW., 2; W. 4.
54	Mar. 23	.490	.182	.00	—.17	1.27	67,670	1.017	68,850	W., 6.
3	Feb. 10	.660	.193	+.02	+.04	1.00	68,750	.982	67,510	SE., 10.
6	Feb. 12	.944	.194	—.06	—.15	1.05	69,320	1.002	69,460	E., 4.
22	Feb. 21	.920	.198	—.06	—.15	1.28	68,700	.993	68,210	W., 4.
51	Mar. 14	.520	.200	.00	—.13	1.36	67,520	.974	65,770	NW., 11.
21	Feb. 21	.850	.211	+.03	+.11	1.28	68,520	1.003	68,760	SE., 3.
46	Mar. 12	.410	.229	+.03	+.16	1.32	67,340	.996	67,050	NW., 11.
1	Feb. 8	.798	.254	+.01	—.03	1.04	68,990	1.011	69,730	SE., 5; SE., 4; SW., 3; W., 6; W., 4.
4	Feb. 10	.685	.256	+.04	+.09	1.00	68,800	.984	67,670	SE., 11.
45	Mar. 11	.538	.258	+.04	+.10	1.34	67,600	1.019	68,870	SW., 5; variable.
5	Feb. 12	.984	.278	.00	—.02	1.05	69,430	.982	68,200	E., 3.
34	Mar. 3	.602	.280	+.10	+.23	1.30	67,870	1.052	71,380	N., 7.
31	Feb. 29	.810	.281	.00	—.08	1.28	68,420	1.013	69,800	NE., 6.
49	Mar. 13	.508	.290	+.05	+.17	1.32	67,570	.973	65,720	SW., 8.

23	Feb. 24	.821	.298	+.02	.00	1.25	68,530	1.011	69,270	W., 8.
29	Feb. 28	.909	.303	—.06	—.08	1.31	68,610	1.008	69,130	NW., 19.
8	Feb. 18	.816	.338	+.03	+.01	1.05	69,010	.994	68,580	0.
15	Feb. 18	.751	.340	+.10	+.28	1.16	68,590	.994	68,210	SE., 8.
9	Feb. 13	.834	.347	+.01	+.11	1.05	69,060	1.035	71,470	SE., 2.
30	Feb. 28	.861	.374	—.02	+.07	1.30	68,500	1.001	68,580	NW., 20.
16	Feb. 18	.827	.410	+.05	—.13	1.16	68,770	1.028	70,670	SE., 10.
27	Feb. 28	.880	.413	—.04	+.05	1.27	68,630	1.026	70,410	NW., 20.
17	Feb. 18	.990	.420	—.02	—.14	1.28	68,890	1.028	70,800	SW., 3.
10	Feb. 14	.952	.422	+.01	+.02	1.13	69,150	1.044	72,220	NW. to N., 13.
11	Feb. 15	.992	.424	—.01	+.06	1.18	69,130	1.031	71,260	NW., 5; variable.
47	Mar. 12	.497	.430	+.08	+.16	1.32	67,550	1.073	72,470	NW., 11.
40	Mar. 7	.646	.438	+.04	—.04	1.34	67,890	1.010	68,600	W., 6.
20	Feb. 20	.874	.450	+.06	+.09	1.28	68,580	1.019	69,870	NW., 9.
33	Mar. 2	.787	.456	+.01	+.05	1.30	68,340	1.057	72,250	NW., 22.
32	...do ...	582.759	.477	+.01	—.10	1.30	68,270	1.052	71,840	NW., 19.
12	Feb. 15	583.033	.537	+.02	+.10	1.18	69,230	1.085	75,130	NW., 15.
18	Feb. 19	583.055	.551	+.04	+.10	1.28	69,040	1.016	70,150	NW., 15.
28	Feb. 28	582.974	.645	+.08	+.18	1.27	68,860	1.087	74,820	NW., 20.
19	Feb. 19	583.099	.650	+.04	+.05	1.28	69,150	1.118	77,290	N. 16; variable.

In Table 3 the measurements are arranged with reference to the bridge gauge, and it is seen that they cover a range of about 1 foot. This range is so small that we can not expect to derive from it a relation between gauge height and discharge which will enable us to foretell the discharge for gauge heights outside of the limits of the observations. It must rather be considered that we have here a group of observations which give with considerable weight the rate of discharge when the level of Lake Superior is about 601.25 feet above mean tide at New York. As an indication, however, of the direction which the curve of gauge relation would assume, we have derived, by the method of least squares, the straight line which most nearly fits all of the observations giving each a unit weight. The equation of this straight line was found to be $Q = 63{,}914 + 17{,}022\,g$ where Q is the discharge in cubic foot-seconds and g is the elevation above mean tide at New York of the water surface at the bridge gauge less 601 feet. This straight line has been plotted on Pl. IV, together with the discharges, taken from Table 3. The greatest error of a single observation from this straight-line equation is about 4.5 per cent.

It is quite probable that the true equation representing this gauge relation is of a higher degree than the first, but the small range in gauge does not warrant the refinement of adjusting a curve to the values obtained, and the fact should be emphasized that the equation as given above must not be expected to apply beyond the limits of the observations.

In the above discharge measurements no account was taken of the direction of the current. The cross section was located as nearly as possible at right angles to the general direction of the stream, and all velocities measured have been treated as if they were flowing normal to it. Small errors of course have been introduced from this source, since the regimen of the river is such that the direction of the current can hardly be the same throughout the cross section.

In closing this report I wish to acknowledge the valuable assistance of Messrs. L. C. Sabin, F. C. Shenehon, and F. H. Reed, assistant engineers, who assisted in making the observations and who have made the greater part of the office reductions, performing all computations in duplicate. Mr. Sabin has assisted materially in preparing this report.

Very respectfully, your obedient servant,

E. E. HASKELL, *Assistant Engineer.*

Mr. E. S. WHEELER, *Assistant Engineer.*

C.—REPORT OF MR. THOMAS RUSSELL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1897.

SIR: I have the honor to make the following report of the field work and reduction of notes of triangulation, completed since July 1, 1896, across the upper peninsula of Michigan, connecting the triangulation of the east end of Lake Superior with the Mackinaw base line.

The measurement of the angles was done with the Troughton & Simms theodolite No. 1, having a horizontal circle 14 inches in diameter, graduated to 5 minutes and read by three equidistant microscopes. In the case of the primary angles ten results were obtained on each angle, read in five different positions of the circle, with the telescope moved, first in the direction of the numbering of the graduation and then against it, according to the method used previous seasons in 1894 and 1895. Four results were obtained on secondary angles in at least two positions of the circle. The run of microscopes was observed for at every station occupied and the readings of circle corrected accordingly.

In observing vertical angles four results were obtained on all the targets sighted to.

The targets used were boards or iron frames covered with cloth, white at top, black in the middle and white at bottom. On the long lines they were 6 feet long and 2 feet wide, and on the short lines from 4 to 8 inches wide.

The party consisting of five persons left the Sault July 7 to take the field at station Duke and was out until November 16. Mr. F. D. Stevens and John Eskeson were rodmen, and W. M. Douglas, cook. Mr. John Conrick was recorder until July 21, when relieved to join the base-line party, after which Mr. L. S. Trowbridge was recorder until September 17.

Six stations were occupied during the season; 43 primary and 24 secondary angles were measured, locating four light-houses and 4 secondary points; 28 vertical angles were measured.

The party and outfit went by rail to Kinross and from there by team to Duke, 6 miles east. Targets had been previously set by Assistant Engineer Glen E. Balch and Mr. Stevens, on the stations at Iroquois Point, Salters Hill, Robinson, and Maple Hill.

The top of tripod of Station Duke is 102.72 feet above the top of surface mark of station, which is about 6 inches above the ground. The work of angle measuring was finished at Duke, July 24, and the next day the camp outfit was moved to Kinross by team, thence by rail to Vinton, and from Vinton into Maple Hill by team. While at Duke a number of men were put to work to make the road into Maple Hill passable for a team. The road leads from Elmwood, a mile west of Vinton, for 3 miles south to the Palms road, and 5 miles west along the Palms road. There are no farms along the route. The station is located on the northern edge of a hill 200 feet high about a mile back from the road. A road had been cut in to the station the previous year by the station-building party. A target was put up on the Mackinac Island station for Maple Hill by Messrs. Conrick and Stevens, and I made a trip by team to Robinson to turn the target at that place.

The instrument was in position and ready for work July 28. The top of tripod of station is 29.55 feet above the ground. The station is marked by a half-inch hole in the natural bed rock which comes to the surface of the ground. Observations for magnetic declination were made on three days. The work at Maple Hill was finished August 10, except the angles to Rabbits Back station. To see the target, which had been placed there by Mr. Haskell, required the cutting of a long line through heavy timber. The lines to the other stations had been cut the previous year. It was decided not to undertake such an extensive cutting until the direction to the station could be accurately ascertained; this could not be known until the angles to Rabbits Back from Robinson and Goose Island were measured.

August 11 camp was broken at Maple Hill and the outfit moved by team to Station Robinson, which took two days. On reaching Robinson and putting the instrument in position, Mr. Stevens was sent to Iroquois station to flash, while I went to Mackinac Island to turn the target there. The target on Rabbits Back had already been turned and a tripod and target put up by Mr. Haskell on Goose Island.

The supplies for the party were brought from the Sault by stage to Pickford and from Pickford to the station by team. The road is south from Pickford 5 miles to Talbots Corners and then west for 2 miles and south 1 mile. The station is on a hill 200 feet high, back of Captain Stevenson's farm about half a mile from the road. Station Robinson is a well-built structure of sawed timber; the top of tripod is 82 feet above the surface mark of station, which is two inches above the level of the ground. The station is marked by a stone cut 6 inches square, with a half-inch hole in the center and the top 2.4 feet below the surface of the ground. There are three reference stones on natural rock at the surface of the ground. The azimuths and distances from the stations to the stones are: For No. 1, 168° 09′ and 139.14 feet; for No. 2, 222° 50′ and 215.39 feet; for No. 3, 329° 12′ and 103.38 feet.

August 19 all was in readiness for work at Robinson. Salters Hill station was visible, but no target could be seen. Mr. Trowbridge was sent by way of Mackinac Island to look after the Salters Hill target, and finding it thrown down, put another one up. The station at Iroquois Point was visible on a sky background, and if a target had been put up it could have been seen though the distance was 30.2 miles. The flash was not satisfactory, being entirely too large, and when it was attempted to work through a smaller aperture the light was off the range a great part of the time. Mr. Trowbridge, being at Sault Ste. Marie, on his way to Robinson, was telegraphed to from Pickford to go to Iroquois Point and put up target and return with Mr. Stevens to Robinson. The target on Iroquois station was plainly visible and very distinct. The angles to it were remeasured, those to the flash being rejected.

It was decided to measure the angle at Robinson to St. Ignace station. A target was put up by Mr. Haskell. After looking for it in vain some time I went over to the point and found it had been thrown down. It was replaced, and after returning to Robinson it was seen but dimly, being shaded from the sunlight by trees the best and steadiest part of the seeing weather. Mr. Stevens was sent to give a flash, but it proved as difficult to see the light as the target. There was a good deal of delay in trying to get this angle, and it was not until September 19 that the work was finished. Four light-houses were sighted to from station Robinson, the lights on Spectacle Reef, Bois Blanc Island, Round Island, and McGulpins Point.

The party moved by team to Hessel September 21, and from there by sailboat to Goose Island. The wind blew a gale for two days, preventing access to the island, and it was not until the 25th that the instrument was in position ready to work. The station, a tripod 4.3 feet above the ground and 11.7 feet above the level of the lake, is situated on the west end of the island, about 96 feet from the water's edge. While camped at Goose Island a visit was made to Point St. Martin and the position of the old station identified and a target placed over it, which was located from Mackinac Island and Goose Island. Point Fuyard was visited too, but the old station was not found. A point somewhere near it was located. The magnetic declination was observed for on three days at Goose Island. The angles were completed October 3, and the same day the party moved to Hessel by sailboat, and from there by steamer to St. Ignace.

October 5 the outfit was moved to Rabbits Back by team and the instrument put in position on the station. The necessary angles being known to determine the direction to Rabbits Back from Maple Hill, I started for Maple Hill with two men, going by rail to Vinton. From there five axmen were taken in to Maple Hill, and having laid out the line, I left the party in charge of Mr. Stevens and returned to the Rabbits Back station, reaching there on the 12th. On the 16th the cutting at Maple Hill had progressed so that the target was visible from Rabbits Back. The next day the chopping party left Maple Hill, having cut a line 2¼ miles through heavy maple timber, and Messrs. Stevens and Eskeson returned to camp.

The station at Rabbits Back is located about 4 miles north of the town of St. Ignace, on a steep hill, 170 feet above the level of the surrounding country. A rope was rigged from the top of the hill to assist in going up and down by hand. The uneven surface of the top of the hill is a triangle in shape, not more than 8 feet on a side. The station is a tripod, the top 4.6 feet above the ground, and is marked by a stone 6 inches square with the top 2 inches below the surface of the ground. While at Rabbits Back a visit was made to Boiling Springs to find the old station. The bank on which it stood had been washed away and the ledge of rock broken off by fishermen from time to time to make sinkers. From Rabbits Back the lighthouse on Bois Blanc Island was sighted to. October 29 the work at the station was finished, and the next day the party moved to St. Ignace by team.

The station at St. Ignace is situated near the point below the town on a hill 113 feet above the level of the lake. The station is a tripod with the top 4.6 feet above the surface mark, a cedar post with a nail in the center. The station is marked by a brass bolt embedded in a rock, with the top 18 inches below the surface of the ground. From St. Ignace the light-houses were sighted to on Bois Blanc Island, Round Island, and McGulpins Point. The work at St. Ignace was completed November 9, and the same day the greater part of the camp outfit was sent by rail to Sault Ste. Marie. The next day the party started with a light outfit for Maple Hill, going by rail to Vinton.

There was heavy rain and snow, and the roads into Maple Hill were in very bad condition. The station was reached on the 12th. A few trees had to be cleared from the line to see Rabbits Back target, the instrument being much lower than the target on station. The angles to Rabbits Back were completed on the 14th, and the party arrived at Sault Ste. Marie the 16th.

In the office, since returning from the field, the notes of the field work have been reduced. The local adjustments of angles were made by the method of least squares for nine stations, and the general adjustments for two quadrilaterals and one hexagon. The lengths of the triangle sides were computed. The geographical positions of the primary and secondary points were computed. The observations for azimuth made at West Base, Mackinaw, were reduced, and also the observations for magnetic declination made during the season. The zenith-distance observations with vertical circle were reduced and tabulated, and the heights of ground at the station derived.

The initial point for the heights is Station Larke, the height of which is 800.95 feet above mean tide, New York Harbor. This was determined by spirit level from the bench mark on lock wall at Sault Ste. Marie, a distance of 4 miles. The elevation of bench mark is 583.29 feet.

The heights derived from the zenith distances are as follows:

Ground at station.	Above mean tide at New York.	Ground at station.	Above mean tide at New York.
	Feet.		*Feet.*
Duke	793.9	Mackinac Island	904.7
Maple Hill	1,000.9	St. Ignace	693.2
Robinson	989	West Base, Mackinaw	650.5
Rabbits Back	750.5	East Base, Mackinaw	616
Goose Island	595		

In Tables Nos. 1 and 4 are given the primary and secondary triangles and the lengths of sides as derived from the Sault Ste. Marie base line.

In Tables Nos. 2 and 3 are given the geographical positions of the primary and secondary triangulation points and the azimuths of the lines dependent on the latitude, longitude, and azimuth observed at Sault Ste. Marie Observatory.

As a check on the triangulation may be noted the location of Spectacle Reef Light, from the end of the St. Marys River triangulation on the line Detour–Drummond, and its location by the triangulation across the upper peninsula from stations Robinson, Goose Island, and Mackinaw Island. The triangle Detour–Drummond–Spectacle Reef is too slender to determine the position accurately, but the angles at Detour and Drummond can be used in connection with the angle at Robinson to determine it. Detour and Drummond are not visible from Robinson. The lengths of lines from Detour to Robinson, and Drummond to Robinson, and the angles in the triangles to

Salters Hill were computed from the angles at Salters Hill and the including sides. With these sides and the angles to Spectacle Reef Light the location of the light was derived.

SPECTACLE REEF LIGHT-HOUSE.

Location.	Latitude.			Longitude.		
	°	′	″	°	′	″
From Mackinac–Robinson	45	46	24.167	84	08	09.192
From Robinson–Drummond	45	46	24.130	84	08	09.159
From Robinson–Detour	45	46	24.130	84	08	00.154

The differences in the location, 0.037″ in latitude and 0.038″ in longitude, amount to 3.7 feet in northing and southing, and 2.7 feet in easting and westing. The latitude of Sault Ste. Marie Observatory is 46° 30′ 06.27″, and the longitude 84° 20′ 48.75″. The length of the line from Sault Ste. Marie Observatory to Spectacle Reef lighthouse is about 270,971 feet. The differences in latitude and longitude of Spectacle Reef correspond to a difference in length of the line of 3.1 feet, or $\frac{1}{87400}$, and a difference of 2.6″ in the azimuth of the line.

Very respectfully, your obedient servant,

THOMAS RUSSELL, *Assistant Engineer.*

Mr. E. S. WHEELER,
Assistant Engineer.

TABLE NO. 1.—*The primary triangulation.*

Stations.	Observed angles.			Local correction.	General correction.	Total correction.	Adjusted spherical angles.			Plane angles.			Log. sines.	Log. sides.	Sides.
	°	′	″	″	″	″	°	′	″	°	′	″		*Meters.*	*Meters.*
Maple Hill	51	31	56.02	+0.01	+0.23	+0.24	51	31	56.26	51	31	55.56	9.8937378	4.4641990	29,120.510
Iroquois	51	13	44.47	-0.14	+0.56	+0.42	51	13	45.19	51	13	44.49	9.8919026	4.4623638	28,997.718
Duke	77	14	19.68	+0.00	+0.96	+0.96	77	14	20.64	77	14	19.95	9.9891380	4.5595992	36,274.317
	180	00	00.47			+1.62			02.09						
Robinson	66	10	24.60	+0.16	+0.32	+0.48	66	10	25.08	66	10	24.58	9.9613133	4.4623638	28,997.718
Maple Hill	42	12	36.54	+0.14	-0.07	+0.07	42	12	36.61	42	12	36.11	9.8272725	4.3283230	21,297.226
Duke	71	36	59.76	0.00	+0.04	+0.04	71	36	59.80	71	36	59.31	9.9772510	4.4783015	30,081.639
	180	00	00.90			+0.59			01.49						
Robinson	48	07	31.47	+0.08	-0.58	-0.50	48	07	30.97	48	07	30.05	9.8719248	4.5595902	36,274.317
Maple Hill	93	44	31.48	+1.23	+0.16	+1.39	93	44	32.87	93	44	31.95	9.9990730	4.6867474	48,612.439
Iroquois	38	07	57.88	+0.28	+0.76	+1.04	38	07	58.92	38	07	58.00	9.7906271	4.4783015	30,081.639
	180	00	00.83			+1.93			02.76						
Robinson	18	02	53.13	+0.08	+0.91	+0.99	18	02	54.12	18	02	53.85	9.4911073	4.4641990	29,120.510
Iroquois	13	05	46.18	+0.28	-0.20	+0.08	13	05	46.26	13	05	45.99	9.3552314	4.3283231	21,297.230
Duke	148	51	19.07	+0.37	+0.99	+1.36	148	51	20.43	148	51	20.16	9.7136557	4.6867474	48,612,439
	179	59	58.38			+2.43			00.81						
Rabbits Back	65	42	57.50	+0.24	+0.66	+0.90	65	42	58.40	65	42	57.81	9.9597655	4.4783015	30,081.639
Maple Hill	60	17	40.75	+0.87	-1.87	-1.00	60	17	39.75	60	17	39.16	9.9388106	4.4573466	28,664.649
Robinson	53	59	24.57	+0.10	-1.05	-0.95	53	59	23.62	53	59	23.03	9.9078010	4.4264370	26,695.436
	180	00	02.80			-1.05			01.77						
Mackinac Island	82	35	44.19	-0.05	-1.01	-1.06	82	35	43.13	82	35	42.87	9.9963630	4.4573466	28,664.649
Rabbits Back	75	22	58.86	+0.69	-0.01	+0.68	75	22	59.54	75	22	59.29	9.9857115	4.4466051	27,970.168
Robinson	22	01	18.03	+0.03	+0.03	+0.06	22	01	18.09	22	01	17.84	9.5739808	4.0349644	10,838.382
	180	00	01.08			-0.32			00.76						
Mackinac Island	54	39	35.38	+0.06	-1.62	-1.56	54	39	33.82	54	39	33.18	9.9115443	4.4783015	30,081.639
Maple Hill	49	19	46.50	+0.50	-0.46	+0.04	49	19	46.54	49	19	45.85	9.8799378	4.4460950	27,970.161
Robinson	76	00	42.75	-0.02	-1.02	-1.04	76	00	41.71	76	00	41.02	9.9860256	4.5530828	35,783.500
	180	00	04.63			-2.56			02.07						

Mackinac Island	27	56	08.65	+0.06	+0.61	+0.67	27	56	09.32	27	56	09.17	9.6706940	4.4264370	26,695.436
Rabbits Back	141	05	56.85	+0.44	+0.66	+1.10	141	05	57.95	141	05	57.79	9.7979399	4.5536829	35,783.508
Maple Hill	10	57	53.46	+1.15	—1.42	—0.27	10	57	58.19	10	57	53.04	9.2792213	4.0349643	10,838.379
	179	59	58.96			+1.50			00.46						
Goose Island	95	38	33.76	+0.32	+0.07	+0.39	95	38	34.15	95	38	33.86	9.9978904	4.4573466	28,604.649
Rabbits Back	33	16	30.11	—0.44	—0.08	—0.52	33	16	29.59	33	16	29.29	9.7392995	4.1987557	15,803.589
Robinson	51	04	57.09	+0.11	—0.05	+0.06	51	04	57.15	51	04	56.85	9.8910079	4.3504641	22,411.149
	180	00	00.96			—0.07			00.89						
Mackinac Island	28	28	09.87	+0.01	+0.16	+0.17	28	28	10.04	28	28	09.86	9.6782356	4.1987557	15,803.589
Robinson	29	03	39.06	+0.08	—0.08	0.00	29	03	39.06	29	03	38.88	9.6864016	4.2069217	16,103.552
Goose Island	122	28	10.80	+0.76	—0.12	+0.64	122	28	11.44	122	28	11.26	9.9261750	4.4466951	27,970.168
	179	59	59.73			+0.81			00.54						
Mackinac Island	111	03	54.06	—0.04	—0.85	—0.89	111	03	53.17	111	03	53.04	9.9699630	4.3504641	22,411.149
Rabbits Back	42	06	30.32	—0.44	+0.07	—0.37	42	06	29.95	42	06	29.81	9.8264206	4.2069217	16,103.552
Goose Island	26	49	37.17	+0.32	—0.20	+0.12	26	49	37.29	26	49	37.15	9.6544633	4.0349644	10,838.382
	180	00	01.55			—1.14			00.41						
St. Ignace	50	13	05.06	+0.36	+0.42	+0.78	50	13	05.84	50	13	05.67	9.8856367	4.4573466	28,664.649
Rabbits Back	117	48	54.34	+1.36	+0.19	+1.55	117	48	55.89	117	48	55.78	9.9466757	4.5183856	32,990.250
Robinson	11	57	59.25	+0.07	—0.55	—0.48	11	57	58.77	11	57	58.60	9.3166746	3.8883845	7,733.650
	179	59	58.65			+1.85			00.50						
St. Ignace	92	04	55.33	+0.48	+0.53	+1.01	92	04	56.34	92	04	56.30	9.9997131	4.0349644	10,838.382
Rabbits Back	42	25	55.48	+0.68	+0.19	+0.87	42	25	56.35	42	25	56.30	9.8291227	3.8643740	7,317.690
Mackinac Island	45	29	07.09	+0.01	+0.35	+0.36	45	29	07.45	45	29	07.40	9.8531332	8.8883845	7,733.650
	179	59	57.90			+2.24			00.14						
St. Ignace	41	51	50.02	+0.36	+0.10	+0.46	41	51	50.48	41	51	50.34	9.8243631	4.4466951	27,970.168
Robinson	10	03	18.67	+0.07	+0.59	+0.66	10	03	19.33	10	03	19.19	9.2420420	3.8643740	7,317.690
Mackinac Island	128	04	51.28	—0.04	—0.64	—0.68	128	04	50.60	128	04	50.47	9.8960536	4.5183856	32,990.250
	179	59	59.97			+0.44			00.41						
East Base	33	58	26.99	—0.03	—0.06	—0.09	33	58	26.90	33	58	26.83	9.7472707	3.8648740	7,317.690
St. Ignace	90	57	29.80	+0.16	—0.05	+0.11	90	57	29.91	90	57	29.85	9.9999392	4.1170425	13,093.100
Mackinac Island	55	04	03.58	—0.26	+0.07	—0.19	55	04	03.39	55	04	03.32	9.9137228	4.0308261	10,735.593
	180	00	00.37			—0.17			00.20						

TABLE No. 1.—*The primary triangulation*—Continued.

Stations.	Observed angles.	Local correction.	General correction.	Total correction.	Adjusted spherical angles.	Plane angles.	Log. sines.	Log. sides.	Sides.
	° ′ ″	″	″	″	° ′ ″	° ′ ″		*Meters.*	*Meters.*
West Base	87 40 31.55	−0.17	+0.95	+0.78	87 40 32.28	87 40 32.28	9.9996425	4.0308261	10,735.503
St. Ignace	37 45 39.61	+0.16	+0.13	+0.29	37 45 39.90	37 45 39.85	9.7870139	3.8181975	6,579.569
East Base	54 33 47.42	−0.03	+0.53	+0.50	54 33 47.92	54 33 47.87	9.9110279	3.9422115	8,754.100
	179 59 58.58			+1.57	00.15				
West Base	64 29 30.04	−0.24	+0.39	+0.15	64 29 30.19	64 29 30.12	9.9554582	4.1170425	13,093.100
Mackinac Island	26 58 14.59	+0.27	+0.34	+0.61	26 58 15.20	26 58 15.13	9.6566131	3.8181974	6,579.568
East Base	88 32 14.03	+0.32	+0.48	+0.80	88 32 14.83	88 32 14.75	9.9998585	4.1614428	14,502.498
	179 59 58.66			+1.56	00.22				
West Base	23 11 01.82	−0.24	+0.55	+0.31	23 11 02.13	23 11 02.09	9.5951476	3.8643740	7,317.690
St. Ignace	128 43 09.06	+0.68	+0.08	+0.76	128 43 09.82	128 43 09.77	9.8922165	4.1614429	14,502.502
Mackinac Island	28 05 48.18	+0.27	−0.27	0.00	28 05 48.18	28 05 48.14	9.6729851	3.9422115	8,754.100
	179 59 59.06			+1.07	00.13				
Salters Hill	Supplied.	....	....	....	84 29 06.34	84 29 05.72	9.7529617	4.3283231	21,297.230
Robinson	71 14 42.31	+0.08	....	....	71 14 42.39	71 14 41.77	9.9763049	4.5516663	35,617.738
Duke	74 16 12.74	+0.38	....	....	74 16 13.12	74 16 12.51	9.9834236	4.5587850	36,206.375
	....	....	....	....	.... 01.85				

TABLE NO. 2.—*The primary triangulation—Geographical positions—The Clarke spheroid of 1866.*

Stations.	Latitude.			Seconds in meters.	Longitude.			Seconds in meters.	Azimuth.			Back azimuth.			To station—	Distance.	Logarithms.
	°	′	″		°	′	″		°	′	″	°	′	″		*Meters.*	
Iroquois	46	28	21.081	650.94	84	39	21.422	457.02	337	28	16.15	157	38	42.30	Robinson	48,612.439	4.6867474
									15	36	15.07	195	30	46.21	Maple Hill	36,274.317	4.5595992
									324	22	29.88	144	32	03.08	Duke	29,120.510	4.4641990
Duke	46	15	33.715	1,041.02	84	26	09.499	202.38	355	40	42.65	175	41	36.51	Robinson	21,297.226	4.3283230
									67	17	42.44	247	02	42.47	Maple Hill	28,997.718	4.4623638
									144	32	03.08	324	22	29.88	Iroquois	29,120.510	4.4641990
Maple Hill	46	09	29.325	905.44	84	46	56.167	1,205.17	195	30	46.21	15	30	15.07	Iroquois	36,274.317	4.5595992
									247	02	42.47	67	17	42.44	Duke	28,997.718	4.4623638
									289	15	19.08	109	31	11.42	Robinson	30,081.639	4.4783015
									338	35	05.63	158	42	21.34	Mackinac Island	35,783.500	4.5536828
									349	32	58.82	169	35	40.57	Rabbits Back	26,695.436	4.4264370
Robinson	46	04	05.905	182.32	84	24	54.779	1,177.31	4	26	50.66	184	26	09.75	Goose Island	15,803.589	4.1987557
									33	30	29.72	213	21	55.16	Mackinac Island	27,970.161	4.4466950
									43	33	49.05	223	21	11.50	St. Ignace	32,990.250	4.5183856
									55	31	47.80	235	18	38.98	Rabbits Back	28,664.649	4.4573466
									109	31	11.42	289	15	19.08	Maple Hill	30,081.639	4.4783015
									157	38	42.39	337	28	16.15	Iroquois	48,612.439	4.6867474
									175	41	36.51	355	40	42.05	Duke	21,297.226	4.3283230
									246	56	18.90	67	14	58.51	Salters Hill	36,206.375	4.5587850
Goose Island	45	55	35.58	1,098.78	84	25	51.654	1,112.99	61	57	58.31	241	50	05.20	Mackinac Island	16,103.552	4.2069217
									88	47	35.60	268	35	08.57	Rabbits Back	22,411.149	4.3504641
									184	26	09.75	4	26	50.66	Robinson	15,803.589	4.1987557
Rabbits Back	45	55	18.986	586.18	84	43	11.460	246.95	169	35	40.57	349	32	58.82	Maple Hill	26,695.436	4.4264370
									235	18	38.98	55	31	47.80	Robinson	28,664.649	4.4573466
									268	35	08.57	88	47	35.60	Goose Island	22,411.149	4.3504641
									310	41	38.51	130	46	12.01	Mackinac Island	10,838.382	4.0349644
									353	07	34.86	173	08	05.66	St. Ignace	7,733.650	3.8883845
St. Ignace	45	51	10.298	317.94	84	42	28.561	616.20	173	08	05.66	353	07	34.86	Rabbits Back	7,733.650	3.8883845
									223	21	11.50	43	33	49.05	Robinson	32,990.250	4.5183856
									265	13	02.00	85	17	04.56	Mackinac Island	7,317.690	3.8643740
									356	10	31.91	176	10	55.66	East Base	10,735.593	4.0308261
									33	56	11.81	213	53	29.55	West Base	8,754.100	3.9422115

TABLE NO. 2.—*The primary triangulation—Geographical positions—The Clark spheroid of 1866*—Continued.

Stations.	Latitude.			Seconds in meters.	Longitude.			Seconds in meters.	Azimuth.			Back azimuth.			To station—	Distance.	Logarithms.
	°	′	″		°	′	″		°	′	″	°	′	″		*Meters.*	
Mackinac Island	45	51	29.922	923.80	84	36	50.537	1,090.24	30	13	01.71	210	09	22.56	East Base	13,093.100	4.1170425
									57	11	16.38	237	04	31.71	West Base	14,502.498	4.1614428
									85	17	04.56	265	13	02.00	St. Ignace	7,317.690	3.8643740
									130	46	12.01	310	41	38.51	Rabbits Back	10,838.382	4.0349644
									158	42	21.34	338	35	05.63	Maple Hill	35,783.500	4.5536828
									213	21	55.16	33	30	29.72	Robinson	27,970.161	4.4466950
									241	50	05.20	61	57	58.31	Goose Island	16,103.552	4.2069217
East Base	45	45	23.350	720.91	84	41	55.429	1,197.99	121	37	07.74	301	34	01.90	West Base	6,579.569	3.8181975
									176	10	55.66	356	10	31.91	St. Ignace	10,735.593	4.0308261
									210	09	22.56	30	13	01.17	Mackinac Island	13,093.100	4.1170425
West Base	45	47	14.995	462.96	84	46	14.815	320.00	213	53	29.55	33	56	11.81	St. Ignace	8,754.100	3.9422115
									237	04	31.71	57	11	16.38	Mackinac Island	14,502.498	4.1614428
									301	34	01.90	121	37	07.74	East Base	6,579.569	3.8181975

TABLE No. 3.—*The tertiary stations and lighthouses—Geographical positions.*

Stations.	Latitude.	Seconds in meters.	Longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To station—	Distance.	Logarithms.
	° ′ ″		° ′ ″		° ′ ″	° ′ ″		*Meters.*	
McGulpins Point Light-House	45 47 14.877	459.32	84 46 15.027	324.58	213 54 10.74	33 56 53.15	St. Ignace	8,759.67	3.9424878
					221 20 17.69	41 35 37.52	Robinson	41,655.18	4.6196690
					237 04 23.29	57 11 08.14	Mackinac Island	14,508.31	4.1616168
Bois Blanc Light-House	45 48 39.167	1,209.23	84 25 07.397	159.67	101 50 05.10	281 37 38.26	St. Ignace	22,951.78	4.3608164
					109 13 38.32	289 05 13.94	Mackinac Island	16,065.03	4.2058814
					117 56 18.07	297 43 20.02	Rabbits Back	26,442.29	4.4222991
					175 45 28.90	355 44 57.18	Goose Island	12,892.12	4.1103264
					180 32 30.22	0 32 39.30	Robinson	28,614.62	4.4565880
Round Island Light-House	45 50 15.303	472.47	84 36 52.900	1,141.64	35 58 01.96	215 54 25.08	East Base	11,132.63	4.0465976
					65 24 30.50	245 17 47.59	West Base	13,348.40	4.1254293
					103 13 36.84	283 09 36.02	St. Ignace	7,439.30	3.8715318
					181 16 03.11	1 16 04.81	Mackinac Island	2,304.36	3.3625496
					211 01 18.43	31 09 54.59	Robinson	29,947.85	4.4763657
					235 11 32.60	55 19 27.31	Goose Island	17,352.90	4.2393720
Spectacle Reef Light-House	45 46 24.167	746.12	84 08 09.192	198.60	104 25 26.09	284 04 51.71	Mackinac Island	38,348.13	4.5836876
					126 42 19.13	306 29 36.80	Goose Island	28,553.88	4.4556652
					146 38 03.14	326 26 00.75	Robinson	39,295.59	4.5943438
					214 48 50.70	34 58 28.40	Detour	30,329.45	4.4818645
					210 43 55.99	39 55 40.50	Drummond	33,032.35	4.5189395
Point St. Martin	45 58 11.384	351.48	84 31 47.879	1,030.89	302 02 58.24	122 07 14.26	Goose Island	9,055.64	3.9569193
					27 47 06.98	207 43 29.58	Mackinac Island	14,006.51	4.1463298
Smokestack at St. Ignace	45 51 19.621	605.79	84 42 07.580	163.53	267 18 23.05	87 22 10.56	Mackinac Island	6,847.17	3.8355108
					358 37 55.42	178 38 04.12	East Base	11,002.78	4.0415028
					35 16 16.80	215 13 19.51	West Base	9,248.16	3.9660554
					57 32 51.71	237 32 36.66	St. Ignace	536.40	2.7294890
					169 26 57.21	349 26 11.38	Rabbits Back	7,517.55	3.8760761
					169 34 15.84	349 30 48.23	Maple Hill	32,469.30	4.5114729
					223 07 31.46	43 19 53.92	Robinson	34,212.22	4.5341818
Flagstaff on Grand Hotel	45 51 04.088	126.21	84 37 27.125	585.25	28 52 12.92	208 49 00.56	East Base	12,009.74	4.0795337
					58 13 02.64	238 06 44.24	West Base	13,408.92	4.1273987
					91 43 06.50	271 39 30.21	St. Ignace	6,506.46	3.8133446
					224 42 01.75	44 42 28.01	Mackinac Island	1,122.14	3.0500468
Magnetic Station at West Base	45 47 22.437	692.68	84 46 13.843	298.99	135 59 54.47	....	St. Helena Light-House	....	....
					214 37 59.97	34 40 41.54	St. Ignace	8,552.37	3.9320864
					237 47 58.62	57 54 42.62	Mackinac Island	14,361.13	4.1571885

TABLE No. 4.—*Triangulation of tertiary stations and lighthouses.*

Stations.	Adjusted angles.			Sides.	Sides.
	°	′	″	*Meters.*	*Miles.*
McGulpins Point Light-House	23	10	12.56	7,317.69	4.547
St. Ignace	128	43	51.15	14,508.31	9.015
Mackinac Island	28	05	56.42	8,759.67	5.443
	180	00	00.13		
McGulpins Point Light-House	15	44	05.60	27,970.16	17.380
Robinson	8	05	07.80	14,506.66	9.014
Mackinac Island	156	10	47.02	41,655.18	25.884
	180	00	00.42		
Bois Blanc Light-House	66	31	50.56	16,103.55	10.006
Mackinac Island	47	15	08.74	12,892.12	8.011
Goose Island	66	13	01.18	16,065.03	9.983
	180	00	00.48		
Bois Blanc Light-House	62	36	12.15	28,664.65	17.812
Rabbits Back	62	24	41.04	28,614.70	17.781
Robinson	54	59	08.51	26,442.29	16.431
	180	00	01.70		
Bois Blanc Light-House	78	42	25.12	32,990.25	20.499
St. Ignace	58	16	26.76	28,614.62	17.780
Robinson	43	01	09.75	22,951.78	14.262
	180	00	01.63		
Round Island Light-House	78	02	26.27	7,317.69	4.547
St. Ignace	17	56	34.02	2,304.36	1.432
Mackinac Island	84	00	59.75	7,439.90	4.623
	180	00	00.04		
Round Island Light-House	29	26	28.54	6,579.57	4.088
East Base	94	17	17.34	13,348.40	8.294
West Base	56	16	14.31	11,132.63	6.918
	180	00	00.19		
Round Island Light-House	24	10	14.17	15,803.59	9.820
Robinson	26	43	03.93	17,352.90	10.783
Goose Island	129	06	42.44	29,947.85	18.609
	180	00	00.54		
Spectacle Reef Light-House	42	12	37.04	27,970.16	17.380
Robinson	67	04	28.97	38,343.13	23.826
Mackinac Island	70	42	56.55	39,295.59	24.417
	180	00	02.56		
Spectacle Reef Light-House	19	55	44.01	15,803.59	9.820
Robinson	38	00	49.91	28,553.88	17.743
Goose Island	122	03	27.05	39,295.05	24.417
	180	00	00.97		
Spectacle Reef Light-House	73	05	53.06	43,365.80	26.946
Robinson	46	47	13.27	33,032.35	20.525
Drummond	60	06	56.82	39,297.05	24.418
	180	00	03.15		
Spectacle Reef Light-House	68	10	48.53	39,725.51	24.685
Robinson	45	08	08.56	30,329.45	18.846
Detour	66	41	05.71	39,296.96	24.418
	180	00	02.80		
Point St. Martin	85	44	08.75	16,103.55	10.006
Goose Island	60	09	15.96	14,006.51	8.703
Mackinac Island	34	06	35.62	9,055.64	5.627
	180	00	00.32		

TABLE NO. 4.—*Triangulation of tertiary stations and lighthouses*—Continued.

Stations.	Adjusted angles.			Sides.	Sides.
	°	′	″	*Meters.*	*Miles.*
Smokestack at St. Ignace	97	51	25.81	10,838.38	6.735
Rabbits Back	38	44	32.87	6,817.17	4.255
Mackinac Island	43	24	01.45	7,517.55	4.671
	180	00	00.13		
Smokestack at St. Ignace	36	38	21.38	6,579.57	4.088
East Base	57	00	56.38	9,248.16	5.747
West Base	86	20	42.39	11,002.78	6.837
	180	00	00.15		
Smokestack at St. Ignace	111	54	05.53	7,733.65	4.806
St. Ignace	64	24	31	7,517.53	4.671
Rabbits Back	3	41	23.48	536.40	0.333
	180	00	00.01		
Smokestack at St. Ignace	53	33	15.63	30,081.64	18.692
Maple Hill	60	15	29.15	32,469.20	20.176
Robinson	66	11	17.5	34,212.22	21.259
	180	00	02.27		
Flagstaff on Grand Hotel	132	58	55,25	7,317.69	4.547
St. Ignace	6	26	28.21	1,122.14	0.697
Mackinac Island	40	34	36.55	6,506.46	4.043
	180	00	00.01		
Flagstaff on Grand Hotel	29	20	49.72	6,579.57	4.088
East Base	87	11	52.82	13,408.92	8.332
West Base	63	27	17.66	12,009.74	7.463
	180	00	00.20		
Magnetic Station at West Base	23	09	58.64	7,317.69	4.547
St. Ignace	129	27	39.54	14,361.13	8.924
Mackinac Island	27	22	21.94	8,552.37	5.314
	180	00	00.12		

D.—REPORT OF MR. H. VON SCHON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1897.

SIR: I have the honor to herewith respectfully submit my report for the fiscal year 1897, relating to those operations in connection with the survey of the Northern and Northwestern Lakes—resurvey of the St. Marys River—of which I have had charge.

Synopsis.—The approved season's programme consists of the location of all "topography and hydrography" required for the completion of the resurvey of St. Marys River and of the extending of a line of "precise levels" to the shore of Lake Huron.

This programme was fully carried out.

The scene of the field operations was all that territory which is embraced in the projected chart No. 1 of the St. Marys River, which extends from the latitude of Old Fort St. Joe south to the mouth of the St. Marys River at Detour Light, a distance of about 7½ miles, and from the shore of the Upper Peninsula of Michigan easterly over Potagannissing Bay to Sulphur Island, off the north entrance to False Detour Passage, a distance of about 19 miles.

The character of the field operations was:

First, extending the established secondary triangulation system to Sulphur Island Light, being the most western point in these waters which has been geodetically determined during the last admiralty survey executed by the Dominion of Canada;

Second, extending the established tertiary triangulation system over the islands of Potagannissing Bay, the south shore of St. Joseph Island, the north shore of Drummond Island, and the Detour Passage;

Third, locating all shore topography within the territory described;

Fourth, sounding all the waters within this territory sufficiently to develop fathom submarine contours; and

Fifth, extending precise levels from a point on the Charlotte River near the Hay Lake shore to Detour Light on Lake Huron shore.

Narrative.—The field organization under my charge consisted of a party of sixteen members, which was housed and subsisted on the U. S. quarterboat *Hay Lake* with the U. S. steam tug *Myra* attached. This party left Sault Ste. Marie, Mich., on July 1, 1896, reaching the first camp at Harbor Island the same day. On July 16, 1896, camp was moved to Burnt Island; on August 20 back to Harbor Island, and on September 3 to Detour, where the party remained until October 6, when it returned to Sault Ste. Marie, Mich., and was disbanded on October 7. On September 23 a party of five members was detached to continue the work of carrying the precise levels over territory too distant from the camp at Detour. The level party remained in the field until October 30, when it also returned to Sault Ste. Marie, Mich., and was disbanded October 31, 1896.

FIELD OPERATIONS IN DETAIL.

Secondary triangulation.—The reconnaissance and planning for this work was executed during the preceding season. The approved system consisted of three quadrilaterals departing from the established secondary line Harbour-Bacon as follows: Harbour-Bacon-Burnt Point-Burnt Island, Harbour-Burnt Island-Kocruish-Chippewa, Chippewa-Kocruish-Serpent-Sulphur, the latter being the objective point.

Two additional quadrilaterals were planned from this system, one northerly from line Kocruish-Serpent to Grande Point and △ 252 on the south shore of St. Joseph Island, and one southerly from line Serpent-Sulphur to △ 343 and △ 345 on the north shore of Drummond Island, in order to locate the terminal points of shore topography at the eastern limit of the surveyed area by secondary determination, as well as checking the tertiary extensions in this direction.

Of the observing stations required in this secondary system, those at Harbour, Burnt Point, and Chippewa had been erected by a construction party during the season of 1894, the first two being described in the Annual Report for 1895, Appendix E E E, page 4177, in the report of Assistant Engineer Glen E. Balch; station Chippewa is located on Drummond Island, on the eastern end of the point of the same name, being about the northernmost point of the island; the top of the tripod is about 12 feet above the surface.

The observing stations at Kocruish and Serpent were constructed during the season of 1895, and are described in my report on page 4058, Appendix E E E of the Annual Report of 1896.

The other stations of the secondary system, namely, Burnt Island, Sulphur Island, △ 252, Grande Point, △ 343, and △ 345 were established and constructed during the season covering this report.

Station Burnt Island is located on the island of the same name, being in American waters, in section 21, range 5 east, township 43 north, on the highest point of land in a small clearing on the land of Mr. Spencer Hill. The geodetic point is a ⅜-inch hole drilled in the top of a cut stone 6 by 6 by 24 inches between the letters U. S. The surface mark is a nail in center of 10-inch wooden post. The top of the observing tripod is about 35 feet above the surface. Station Sulphur is on Sulphur Island, being in Canadian waters, about 3 miles northerly from the northeast end of Drummond Island and off the north entrance to False Detour Passage. The geodetic point is the center of the light tower located on the south end of the island.

Station Grande Point is on St. Joseph Island on the point of land of the same name, which is the easternmost point of the island. The geodetic point is a hole drilled in the top of a large granite bowlder inside of a square. The top of the tripod is about 12 feet above the surface.

Station 252 is located on Caradoe Point, on the south shore of St. Joseph Island, the geodetic point and the tripod being the same as described for station Grande Point.

Stations 343 and 345 are located on the north shore of Drummond Island, the geodetic points being holes drilled in large bowlders and the observing tripods being 5 feet high.

The methods followed in the secondary triangulation work were those usual with direction instruments, the angles being measured with the Pistor & Martins transit No. 218. The system contained 20 separate triangles, involving the measuring of 60 different angles. The longest line in the system is Kocruish-Sulphur, being 13,679.62 meters.

TERTIARY TRIANGULATION.

The tertiary triangulation covering the territory was planned as a continuous system of quadrilaterals, departing from and closing on the established secondary line Harbour-Bacon. This system embraced 51 stations which were occupied by surface tripods firmly anchored, the station point being marked on a stone below surface with wooden post above. Each tripod had its corresponding station number cut on the face. Thirty-seven of these stations are located on as many different islands, 4 on St. Joseph Island, 8 on Drummond Island, and 2 on the upper peninsular shore. The system contained 98 triangles, requiring the measuring of 285 separate angles. In addition to these, 45 angles were measured for the determination of 15 lights and buoys. The instrument employed in this work is the Buff & Berger transit No. 245, and the methods followed those usual with repeating instruments. All pointings were made to targets fixed in top of station tripods.

TOPOGRAPHY.

The topographical field operations consisted in the location of all the shore lines, of details important to navigation, of elevations for development of 20-foot contours, of roads, houses, timber limits, and all other topographic inshore features within the territory of the programme, resulting in the complete survey of all the islands and shore lines within the area of projected chart No. 1, St. Marys River, as far as the mouth of the St. Marys River at Detour Light and extending along the north shore of Lake Huron from Detour Light westerly to Carlton Bay, and easterly to and including Whitney Bay on the south shore of Drummond Island. The instruments employed in this work were the transit, plane table, and Wye level, and the general methods followed those of the stadia survey referred to and controlled from triangulation points.

In the course of this work the following points were instrumentally occupied: Eleven secondaries, 55 tertiaries, 387 transit, and 329 plane-table stations.

The distance of developed shore line thus located was about 121.5 miles. The highest elevation found was near Detour, about 724 feet above mean tide, New York.

All topography located was plotted on 29 plane-table sheets of the approved form on a scale of 1:10000.

HYDROGRAPHY.

The hydrographic field operations consisted in sounding over all the waters between the islands in the territory covered, and of the detail surveys of all shoals near navigable water. The method employed in shallow waters—less than 3 fathoms—was to sound with poles from small boats being rowed along lines between fixed shore ranges, and in deep waters by sounding with lead lines from the steam tug running at the speed of 3 miles per hour and being pointed to by 2 transits from triangulation stations simultaneously, at intervals of five minutes or less. Sufficient sounding lines were planned to thoroughly cover the territory, the individual soundings being taken at 50-foot intervals or less. Only suitable calm days were devoted to this work.

The total distance of developed sounding lines was about 99 miles in shallow waters and about 178 miles in deep waters, making in all about 30,000 individual soundings.

Nine shoals were surveyed by control from nearby triangulation stations and fixed buoys.

The deepest soundings were found to be about 150 feet in the Detour Passage.

All hydrographic field work was reduced and platted on the before-mentioned plane-table sheets.

PRECISE-LEVEL WORK.

The extension of precise levels to the shore of Lake Huron was entered upon during the season of 1895 and reported on by me as on pages 4058, 4059, and 4060 of Appendix E E E of the Annual Report for 1896. The work was completed during the season covered now.

A special report treating of this work and containing description of lines run, of permanent bench marks established, of methods employed, and of the results secured is hereto attached.

The office operations which were carried on under my charge during the period reported on have consisted of the reduction and adjustment of the secondary and tertiary triangulation, the computation of geographical coordinates for secondary points, and of rectangular coordinates for tertiary points, and lights and buoys, and of the tabulating of the resulting data in tables 1, 2, 3, and 4 hereto appended; of platting all topography located and of all soundings made; of reducing, adjusting, and tabulating the data resulting from the precise-level work, and of continuing the compilations on the approved form of record sheets No. 29, Milford Haven; No. 30, Serpent; No. 31, Sulphur Island, which leaves record sheets No. 32, Chippewa; No. 33, Potagannissing; No. 34, Maud Bay; No. 35, Detour; No. 36, Detour Passage, yet to be compiled in order to fully complete the uniform office records of the entire topographic and hydrographic surveys executed during the seasons of 1893, 1894, 1895, and 1896 on the project of the resurvey of the St. Marys River.

FINANCIAL STATEMENT.

The total expenditures for field operations under my charge during the fiscal year 1897 were as follows:

For salaries	$3,336.51
For subsistence	965.43
For fuel	138.80
For outfit and repair of same	245.04
For 20 per cent of original cost of instrument outfit, the same amount having been charged to field operations for fiscal years 1894, 1895, and 1896	61.00
Total	4,746.78

Of this amount the proper allotment to the various operations is as follows:

Triangulation	$1,680.73
Topography	1,140.58
Hydrography	1,061.87
Precise-level lines	863.60
Total	4,746.78

PERSONNEL.

During the season I was assisted by Recorders Andrew J. Swift and Howard N. Eavenson, who performed their various duties at all times in the most satisfactory manner. Recorder H. N. Eavenson had personal charge of the precise-level work, and proved himself in every way highly proficient to execute the work he was intrusted with. I also desire to acknowledge the valuable assistance of Rodman Murray Blanchard, who, during the greater portion of the field season, was in charge of instrumental work, in all of which he proved himself conscientious and painstaking.

Very respectfully, your obedient servant,

H. VON SCHON, *Assistant Engineer.*

Mr. E. S. WHEELER, *Assistant Engineer.*

E.—REPORT OF MR. H. VON SCHON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1897.

SIR: I have the honor to herewith submit a special report on the completed extension of precise levels from Charlotte River to Detour light, which work has been under my charge.

Synopsis.—The programme for this work, as approved in August, 1895, consisted of the extending of the precise-level line which was carried from Sault Ste. Marie, Mich., to the Charlotte River, a distance of about 15 miles, in 1883, to the shore of Lake Huron, near the Detour light, being a distance of about 52 miles.

Narrative.—The field work was entered upon on September 18, 1895, and continued to November 18, 1895, but by reason of the extreme inclemency of the weather during this period, only nineteen days could be utilized, and the line was only carried over about one-fifth of the required distance. The work was again taken up on September 3, 1896, and completed on October 30, 1896.

DESCRIPTION OF PRECISE-LEVEL LINE LOCATION.

The beginning of the projected extension was P. B. M. 3½, being the southernmost bench mark on the line of precise levels carried from P. B. M. "F" on the wall of the Weitzel Lock in 1883 by Joseph Ripley, assistant engineer. This bench is described as the top of a boat spike driven in a cut in the east side of a double elm tree standing on the east side of the Hay Lake road, and on the south bank of the Charlotte River. The bench was found and identified, but in accordance with your instructions, another P. B. M. was established in close vicinity of P. B. M. 3½. The actual point of beginning of the line of precise levels carried under my charge from Charlotte River to Lake Huron is therefore P. B. M. Charlotte River, about 140 feet south of the south bank of Charlotte River and on the east side of the Hay Lake road; thence the line continues south along the Hay Lake road to the intersection of the Rosedale road about 700 feet; thence westerly along the Rosedale road to the intersection with the County road about 1 mile; thence southerly along the County road about 3 miles; thence easterly along the County road about half a mile to P. B. M. Barbeau Settlement; thence easterly along the County road about half a mile; thence southerly along the County road about 1 mile; thence easterly along the County road about three-quarters of a mile; thence generally southerly following the County road for a distance of about 4 miles to the crossing of Little Munuskong River at Keldon post-office; thence southerly along the County road about 1,400 feet to P. B. M. Munuskong; thence southerly along the County road for about 1 mile to the Big Munuskong River; thence westerly along a road and the north side of the Big Munuskong River for about three-quarters of a mile; thence southerly along the County road crossing the Big Munuskong River and continuing along said road southerly for a distance of about 3 miles to P. B. M. Kelley; thence easterly along a road for 1 mile; thence southerly along a road for 1 mile; thence easterly along a road for 1 mile; thence southerly along a road for 1 mile to P. B. M. Fairview at Sims Corner; thence southerly along the same road for 1 mile; thence easterly along the County road for 1¼ miles; thence southeasterly along the same road for one-half a mile; thence southerly along the same road for three-quarters of a mile to Tripps Corner; thence easterly along the County road for 1 mile to P. B. M. Tripp; thence southerly along the same road for 1 mile; thence easterly along the road for 2 miles; thence southerly along the County road for 1 mile; thence easterly along the road for half a mile to P. B. M. Hudsons Corner; thence southerly along the road for 1 mile; thence easterly along the road for about 3 miles to P. B. M. Gatesville.

From this point a branch line was run northeasterly along the Raber road for a distance of about 2 miles to P. B. M. Raber, being near the shore of St. Marys River.

From P. B. M. Gatesville the line follows the road southerly for about 2 miles, thence southeasterly for about 1 mile, thence easterly for half a mile, thence southerly for about 1 mile to P. B. M. Schlesser, at Rusks Corner, thence southerly for about 1 mile to Camerons Corner, thence generally easterly along the Detour road for about 4¼ miles to P. B. M. Caribou Lake, on the south side of Caribou Lake, thence continuing generally easterly along the same road for about 4 miles to P. B. M. Detour, in the village of Detour and at the southwest corner of Superior and Drummond streets, and thence generally southwesterly along a road for about 3 miles to P. B. M. Detour Light, being under the light tower and the terminal of the Precise Level line.

DESCRIPTION OF PERMANENT BENCH MARKS.

Thirteen permanent bench marks were established along the line, the location of each being described as follows:

Permanent bench mark Charlotte River is described as being the top of a ⅝-inch iron bolt, projecting about 2 inches above the top of a cut stone 2 feet long and 6 inches square, with the letters "U. S." cut in top of stone. The stone rests on a stiff clay bottom, its top being about 3 feet below the surface of the ground. A cedar post 4 inches square stands on top of the stone and about 1 foot above surface, with the letters "U. S. B. M." cut in its faces. It stands about 3 feet from east side of Hay Lake road and about 140 feet south from the south bank of Charlotte River. It is referred to the following witnesses:

A stone 4 inches square and projecting about 5 inches above ground with letters "U. S." cut in its side, south 64° west, 59 feet from P. B. M. Charlotte River.

P. B. M. 3½ is north 50′ west, 126.4 feet from P. B. M. Charlotte River.

The northeast corner of a house on east side of road is south 1° 10′ east from P. B. M. Charlotte River.

The southeast corner of a house on west side of road is south 20° 40′ west from P. B. M. Charlotte River.

Permanent bench mark Barbeau Settlement (formerly called Barber) is described as being the top of a ½-inch iron bolt, projecting one-half inch above the top of cut stone 2 feet long and 6 inches square, with its top about 3 feet below the surface of the ground. A cedar post 4 inches square is set on top of stone and projects about 1 foot above the ground, with the letters "U. S. B. M." cut in two sides. The bench mark is on the south side of the road, 3 feet from the fence on top of a little knoll, with the following references to witness:

A small oak tree on south side of road is south 89° 15′ east, 189.5 feet from bench mark.

The southeast corner of a house north of road is north 18° east from bench mark.

The southeast corner of a barn south of road is south 86° 15′ west from bench mark.

Permanent bench mark Munuscong is described as being the top of a ¼-inch iron bolt projecting about half an inch above the surface of a cut stone 2 feet long and 6 inches square, which is set in the ground resting on stiff clay bottom, with its center about 3 feet below the surface of the ground. A cedar post 5 inches square is set on top of stone and projects about 10 inches above ground. P. B. M. Munuscong stands in the Munuscong road near the east side of it 3 feet from the fence, near the northwest corner of Walter Todd's field, with the following references to witnesses:

To quarter-section post north 15″ west, 212 meters from P. B. M.

To northwest corner of barn south 2° 30′ east, 91 meters from P. B. M.

To northeast corner of house south 12° 15′ west, 243 meters from P. B. M.

Permanent bench mark Kelley is described as being the top of an iron bolt leaded into a stone 6 inches square on top and 20 inches high. The bolt is about one-half inch above the stone and is between the letters "U. S." cut into the top of the stone. A cedar post 6 inches in diameter, squared to 4 inches on top, has the letters "U. S. B. M." cut into opposite sides, is placed above the stone, but is separated from it by a layer of clay. The post projects 3 feet above the ground. The stone is buried in the clay with its top 2.5 feet below the ground. It is on the south side of the road, and will be east of the other road when it is opened. No trees of sufficient size are near it to which it could be referred. The stone is 1 mile east and 1 mile south of Sterlingville and 3 miles east and 1 mile north of Pickford.

Permanent bench mark Fairview is described as being the top of a ⅝ inch iron bolt, set in the top of a stone 6 inches square on top and 20 inches high. The bolt projects one-half inch above the stone, which has the letters "U. S." cut into its upper face. The stone is buried in sand, with its top 2.5 feet below the surface of the ground. A cedar post 6 inches in diameter, with its top squared to 4 inches and the letters "U. S. B. M." cut into opposite faces, is set over the stone, but is separated from it by a layer of sand.

The stone is near the Fairview schoolhouse and is on the northeast corner of the road. It is 5 miles east and 1 mile south of Pickford and 3 miles north and 1 mile west of Stalwart.

Permanent bench mark Tripp is described as being the top of a ⅝-inch iron bolt in the top of a stone 6 inches square on top and about 20 inches high. The bolt projects about one-half inch above the top of the stone, which has the letters "U. S." cut into it, one on each side of the bolt. The stone is buried 2.5 feet below the surface of the ground and rests in sand. A cedar post 6 inches in diameter, 4 inches square on top, with the letters "U.S.B.M." cut into its opposite faces, is placed over the stone, but is separated from it by a layer of sand.

The stone is on the east side of the road, at the turn by the bluff.

Three trees have been blazed and marked "R. P." and a nail was put on each blaze.

The stone is 1 mile east of Tripps Corner and 2 miles east and 1 mile north of Stalwart.

Permanent bench mark Hudsons Corner is described as being the top of an iron bolt leaded into a cut stone about 6 inches square on top and 20 inches high. The bolt is about one-quarter inch in diameter and projects one-quarter inch above the surface of the stone. The stone is buried in the sand, with its top about 2.5 feet below the ground. The letters "U.S." are cut into the top of the stone. The stone is set 6 feet south of a fence, 8.5 feet southeast of a telephone post, and 47 feet northwest of a section corner stake. A cedar post 6 inches in diameter, with its upper end 4 inches square, has the letters "U.S.B.M." cut into opposite faces, and is directly over the stone, with about 6 inches of sand between the top of the stone and the bottom of the post. The post projects 10 inches above the ground.

Permanent bench mark Gatesville is described as being the top of a ⅝-inch iron bolt set in the top of a stone 6 inches square on top and 20 inches high, with the letters "U.S." cut into its upper face. The bolt projects about five-eighths of an inch above the stone. The stone is buried in sand, with its top about 3 feet below the surface of the ground, and a cedar post 6 inches in diameter, squared to 4 inches on top, with the letters "U.S.B.M." cut into its opposite faces, is placed over the stone, but is separated from it by a layer of sand. The post projects 2.5 feet above the ground.

The stone is buried on the north side of the county road 1 mile north of Gatesville. It is 7 feet west of a large hemlock stump at the corner of the road.

Permanent bench mark Raber is described as being the top of an iron bolt set in the top of a stone 6 inches square on top and 20 inches high. The bolt projects about one-half inch above the stone, between the letters "U. S." cut in its upper face. A cedar post 6 inches in diameter, squared to 4 inches on top, has the letters "U. S. B. M." cut into opposite faces, and is placed over the stone. It projects about 2 feet above the ground. The stone is buried in the sand, and has its top about 2.5 feet below the ground. It is on the south side of the road, below the blacksmith shop.

Permanent bench mark Schlesser is described as being the top of a ⅝-inch iron bolt projecting about one-quarter of an inch above the top of a stone 6 inches square on top and 20 inches high. The stone has the letters "U. S." cut into its upper face. The stone is buried in the sand, with its top about 2.5 feet below the surface of the ground. A 6-inch cedar post, 4 inches square on top, and with the letters "U. S. B. M."

cut into opposite faces, is placed over the stone, and is separated from it by a layer of sand. The stone is at Rusks Corner, near the Schlesser schoolhouse, and is on the west side of the road, and about 2.5 feet from the middle of it. The stone will be in the center of the road to Schlesser when it is opened.

Permanent bench mark Caribou Lake is described as being the top of an iron bolt three-eighths of an inch in diameter and projecting one-quarter of an inch above the top of the stone. The stone is 6 inches square on top and 20 inches high. It has the letters "U. S." cut into its top face. It rests on sand, and its top is about 3 feet below the ground.

The bench mark is on the northeast side of the road about 350 meters east of where the road first touches the lake shore. A cedar post 6 inches in diameter, squared to 4 inches on top, and the letters "U. S. B. M." cut into its opposite sides, is placed over the stone, and projects about 3 feet above the ground. About 4 inches of sand separates the bottom of the post and the top of the stone.

Permanent bench mark Detour is described as being the top of an iron bolt set in a cut stone 6 inches square on top and about 20 inches deep. The bolt is about three-eighths of an inch in diameter and projects about one quarter of an inch above the stone. The stone has the letters "U. S." cut in top, one on each side of the bolt.

The bench mark is situated at the southwest corner of Superior and Drummond streets, between the sidewalk and the street. It is about 2.5 feet below the surface of the street, and a cedar post 6 feet long and 6 inches in diameter, with the top squared to 4 inches and with the letters "U. S. B. M." cut into opposite sides, is placed above it. The post projects about 3 feet above the surface of the ground.

Permanent bench mark Detour Light is described as being the center of a cross cut in the cast-iron anchor plate at the northwest corner of the Detour light-house. The point is midway between the post and the northwest bolt in the plate, and is marked "U. S. × B. M." The letters are cut into the plate.

The temporary bench mark is a cross in the top of the large rock just north of the light-house. The cross is on the southwestern corner of the rock, and is marked with black paint, and has the letters "F. B. M." painted beside it.

Record sheet No. 37, "Precise Levels," containing a general topographic plot of the location of the entire level line on a scale of 1:40,000, and detail topographic plots of the thirteen permanent bench marks established on a scale of 1:10,000, is hereby respectfully submitted as part of this report.

FIELD WORK.

The party executing this work consisted of five members, Recorder Howard N. Eavenson being in charge. The instruments used were the Kern level No. 2 and the precise level rods No. 3 and No. 5.

The party camped in tents, and was moved from time to time by a team attached to it permanently.

The method followed was generally that laid down in "Instructions for making precise levels," as appearing in Appendix O O, pages 2426–2429, of the Annual Report of 1880 in the report of L. L. Wheeler, assistant engineer.

The instrument constants were determined at the beginning and after the completion of the work; the errors of collimation and inclination were determined at the beginning and end of each day's operations, and return levels were carried over lines between bench marks until the discrepancy between the two lines was brought within the permissible limit equal to 5 mm. $\sqrt{\text{distance in kilometers}}$.

In addition to the carrying of the precise levels, detail topographic survey was made of the entire line and so much of the adjoining country as was instrumentally obtainable from the line. This survey was made by transit and plane table according to the methods of the stadia survey. The plat of this survey has already been referred to as being herewith submitted.

RESULTS.

All the field notes were reduced and the resulting data adjusted and tabulated under my direction by Recorder Howard N. Eavenson; but owing to the fact that I have been on continuous leave of absence since the completion of the field work of which I had charge, I have not had an opportunity to make that duplicate reduction and adjustment check which I should be desirous to make before reporting the tabulated results.

It also appears that greater precision might be secured were the absolute lengths of rods No. 1 and No. 5 determined by something better than comparison with rod No. 2, the latter being the only one of the set of which the absolute length was determined by comparison with a standard meter. (See report of Mr. F. W. Lehnartz, assistant engineer, Appendix L L, p. 1387, Annual Report of 1878.)

FINANCIAL STATEMENT.

The total cost of the work of extending the precise levels has been as follows:

For season 1895	$710.52
For season 1896	863.60
Total	1,574.12

Very respectfully, your obedient servant,

H. VON SCHON, *Assistant Engineer.*

Mr. E. S. WHEELER,
Assistant Engineer.

C C C 2.

PRESERVATION OF BENCH MARKS ALONG THE ERIE CANAL.

REPORT OF MAJ. WILLIAM S. STANTON, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 20, 1897.

GENERAL: I have the honor to subjoin hereto my annual report for the fiscal year ending June 30, 1897, of work for the transfer and security of certain bench marks established by the United States Lake Survey in 1875 along the line of the Erie and Oswego canals. The bench marks were transferred under an allotment from the appropriation for "Survey of Northern and Northwestern lakes," 1895.

Very respectfully, your obedient servant,

W. S. STANTON,
Major, Corps of Engineers, U. S. A.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

[Allotment for securing the United States Lake Survey bench marks threatened with obliteration by the enlargement of the Erie Canal.]

In the enlargement of the Erie Canal the lengthening and raising of the walls of the locks and the raising of the bridge piers, now in progress by the State of New York, would obliterate the following bench marks, which were cut upon the locks and piers and which, in November, 1896, were temporarily transferred as follows by Mr. John C. Churchill, jr., assistant engineer:

No. 15, at Aqueduct, N. Y., transferred to top of an iron rod firmly driven in the ground and buried beneath the surface.

No. 15a, at Aqueduct, N. Y., transferred to a point on Canal Lock 21, which will not be disturbed.

No. 40, near Ilion, N. Y., transferred to a nail in an oak post buried beneath the surface of the ground in the canal bank.

No. 40a, near Ilion, N. Y., transferred to a pier in the bridge just west of Lock 43, which will not be disturbed.

No. 48, at Rome, N. Y., transferred to the top of a stone pier of a gristmill near Jay Street Bridge, Rome, N. Y.

The bench marks thus temporarily transferred will be transferred back to the locks and bridge piers when the alterations to them are completed.

The bench marks are described on pages 611 and 613, volume 24, Professional Papers, Corps of Engineers, U. S. A., Primary Triangulations, United States Lake Survey.

C C C 3.

EXAMINATION OF SHOAL IN LAKE ERIE.

REPORT OF COL. JARED A. SMITH, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, September 6, 1897.

GENERAL: In submitting my annual reports for year ending June 30, 1897, through an oversight a report of an examination for a shoal in Lake Erie was not included, owing to the fact that a report covering the principal points had been previously submitted.

* * * * * * *

I therefore have the honor to forward the report in a complete form, together with a summary, both in duplicate.

Very respectfully, your obedient servant,

JARED A. SMITH,
Colonel, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, September 17, 1896.

GENERAL: In compliance with your instructions in letters dated January 8, 1896, inclosing "Extract from a wreck report signed by the master, of stranding of the steamship *John Oades*, of Detroit, Mich., on October 16, 1895," and in letter dated March 10, 1896, forwarding copy of Lake Erie Coast Chart with certain corrections and notations, I have the honor to submit a report, as follows:

It was impracticable to take any steps toward making the examinations required until after opening of navigation in the spring, when the pressing duties of laying out and supervising works in progress occupied the entire time of the small steamer and party employed for such purposes until the latter part of July.

On July 21, 1896, Mr. William T. Blunt, assistant engineer, commenced the examination, employing for the purpose the steamer *Swansea*, with a crew of six men, all told, the party being so organized that when at work away from the steamer the only persons left on board were the engineer and the cook. On the second day of the examination a rock was found of such a dangerous character that it is a matter of some wonder that it had not been a cause of serious injury to vessels long before it was struck by the *John Oades*.

The rock appears to be a part of the regular limestone formation found in that section of Lake Erie, and it projects abruptly about 6 feet above the general level of the surrounding bottom where the depth of water at mean level of the lake is about 19 feet. On the west end of the shoal are bowlders, over which the depth of water is but 11 feet.

At the time the *John Oades* was nearly wrecked by striking the rock, the surface level of the lake was about 3 feet below mean level, so that the depth over the bowlders was but 8 feet, and but 10 feet over most of the rock itself. The rock is nearly 350 feet long, and has a varying width, the two ends being broader than in the middle, and the extreme width nearly 150 feet.

The axis of the rock is nearly east and west, and its location is more than half a mile distant from the point indicated in the wreck report.

As soon as the rock was found Mr. Blunt made a preliminary report, and when its characteristics were more fully determined notice was given to the newspapers, and a preliminary report was made to the Chief of Engineers, as follows:

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, July 27, 1896.

GENERAL: It gives me great satisfaction to report that in the morning of July 22 my assistant, Mr. William T. Blunt, found the unknown rock indicated in wreck report with your letter dated January 8, 1896.

Other work which demanded immediate attention delayed this examination until a few days before the rock was found, so that the examination could not be made earlier.

The survey is not yet complete, but I give the location as first determined with a brief description.

The rock is shaped like a dumb-bell, having over several places near its westerly end only 11¼ feet of water, and in one place only 11 feet. There is 19 to 20 feet all around in this vicinity. The rock is nearly a mile from the location given in the wreck report.

Mr. Blunt says: "It may be platted on Coast Chart No. 6 (of Lake Erie), one-eighth inch southwest from 'c' in 'clay and sand,' due west from the west point of Kelley Island (Carpenter Point)."

Bearings and distances, as follows:
Marblehead Light-House, SE. by S. ⅛ S.
East edge Ballast Island, N. ⅜ W.
Lakeside Dock, S. by E. ⅛ E.
South Point of South Bass Island, NW. by W. ⅛ W.
Black Can, Scott Point Shoal, W. ¼ N. 2⅛ miles.
Carpenter Point (Kelley Island), E. ⅜ N. 1⅜ miles.

I shall forward a more complete report with survey as soon as the map is completed.

Very respectfully, your obedient servant,
JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. WILLIAM P. CRAIGHILL,
Chief of Engineers, U. S. A., Washington, D. C.

The rock is more than five-eighths of a mile from the location given in the wreck report, but it is without doubt the same as that on which the steamer *John Oades* was injured. The rock has been marked by a red and black buoy with horizontal stripes, but as the ice of the ensuing winter will undoubtedly carry the buoy away, I fully concur in Mr. Blunt's recommendation that the necessary steps be taken to have it placed on the regular buoy list of the Light-House Establishment.

A further search developed the presence of three other rocks of less importance, which are fully described in Mr. Blunt's report.

Mr. Blunt reports that the 16-foot shoal shown in red on the chart, received from Chief of Engineers with letter dated March 10, 1896, just east of the 11-foot reef, does not exist.

The rock reported east of Kelley Island has not been found, for reasons given in Mr. Blunt's report which is appended hereto, and to which I invite attention, especially to the remarks and suggestions contained in the closing paragraph. I return by mail the chart received with your letter of March 10, 1896, with the location of rocks discovered in this examination platted thereon.

The allotment of funds for this survey was $750, all of which has been expended or covered by obligations incurred.

In concluding this report I take pleasure in making special mention of the zeal and efficiency displayed by Mr. Blunt in making the examination, which is fully shown by the immediate and satisfactory results.

Very respectfully, your obedient servant,
JARED A. SMITH,
Lieut. Col., Corps of Engineers, U. S. A.

Brig. Gen. WILLIAM P. CRAIGHILL,
Chief of Engineers, U. S. A.

REPORT OF MR. WILLIAM T. BLUNT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, August 29, 1896.

SIR: I have the honor to submit the following report of the examination recently made in the vicinity of South Bass and Kelley Islands, for the location of obstruction upon which the steamer *John Oades* struck October 16, 1895.

The copy of report upon which the examination was based stated that the *Oades* struck an unknown rock 2 miles ESE., from Starve Island Buoy.

A copy of the "protest" filed by Captain Lemay of the *Oades* immediately after the accident, kindly furnished me by Mr. A. A. Parker, the owner of the boat, states: "In going through South Passage, in the middle of the channel, after passing the can buoys on Starve Island and Mouse Island and when about 1½ or 2 miles toward Marblehead, at about 8 o'clock on the morning of the 16th, we struck hard right in the middle of the passage on an unknown rock and immediately commenced to fill."

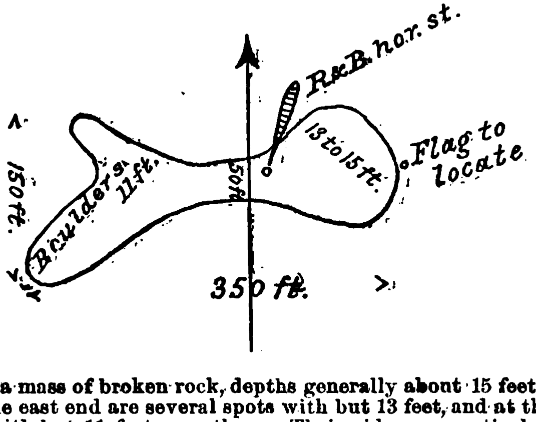
On July 23, during the search, I boarded the *Oades* on her way through the passage. The captain's statement then was in substance as follows: "Came through the passage on the morning of 16th October, 1895, from Bar Point hunting for consort. Kept chart course, SE. by E., until abreast of Scott Point Buoy, when hauled up one point and headed ESE., thinking barge was off Kelley Island. Drew 14 feet. Ran about 1½ or 2 miles (judging only by the time engineer was below oiling, which usually consumed five or six minutes) on a probable speed of 12 miles per hour. Struck an obstruction, rose four feet out of water, rolled off at once. On examination found boat was filling, so headed for Kelley Island Docks. Boat steered badly. After some time wheelman was asked what course and answered ENE. Bright, clear morning, hard westerly wind blowing, and had continued all night. Found seven frames crushed."

My own record of gauge at Sandusky shows water surface to have been 3 feet below mean level at the time of wreck, and West Sister gauge agrees.

Several other boats have struck in the same general locality, among them being the *American Eagle* of Put-in-Bay, in the winter of 1894–95. The location given me by her captain, Nagle, was on the exact course from Lakeside Dock to "just clear" Ballast Island to the eastward. His side ranges were only useful in a very general way. He was drawing but 12 feet, with no sea and 2 or 3 inches of ice.

As it would be a season's work to examine all the area covered by these conflicting locations, I concluded to combine the most plausible elements for a first search. A buoy was placed at the intersection of the *Eagle* range and the *Oades* bearing (ESE. of Starve Island Buoy, as officially sent you), and from this ranges were laid out parallel to the Lakeside-Ballast Island range. Systematic search was begun by sweeping just clear of the bottom with a gas pipe 38 feet long hung by lines from two rowboats. Ranges were 60 feet apart, so that with one boat on a range the pipe lapped surely over each sweep on either side.

The first day's sweeping discovered a shoal spot, which upon close examination the next day proved to be a reef of jagged rocks about 350 by 150 feet in extreme dimensions, narrowing at the middle to about 50 feet width. Its shape is as in sketch.



It consists of a mass of broken rock, depths generally about 15 feet with 19 feet in clefts. Near the east end are several spots with but 13 feet, and at the west end are two bowlders with but 11 feet over them. Their sides are vertical, so that the rod drops at once to 19 feet. Edges of reef are quite indefinite, but the surrounding bottom is gravel and small stone. A flag placed at the east end of reef was located by sextant angles to prominent land marks and can be readily replaced. A rough spar buoy with red and black horizontal stripes was placed on the reef. It is directly on the course from Lakeside to Ballast Island, continually run by passenger boats large and small. It is almost due ESE. from Starve Island Buoy 2¼ miles, and directly on the course from abreast of this buoy to Kelley Island Docks. It is thus an exceedingly dangerous place and I respectfully suggest that steps should be taken to place it on the regular buoy list of the Light-House Establishment. Although I felt reasonably sure that this reef was the one the *Oades* struck, yet in my conference with Captain Lemay he was so sure that he was not so far north and east, that I concluded to continue the search upon the course he gave verbally, i. e., ESE. of Scott Point Buoy. The *Swansea* was run on that course for the distance indicated and a location flag dropped. Ranges were laid out parallel to the course, and an area of 1,000 feet width by nearly a mile in length was carefully swept as described above. In this area two rocks were found. One covered about 100 square feet, and had $17\frac{3}{10}$ feet over its highest point. Another covered about 400 square feet, and had $17\frac{4}{10}$ feet upon it. Each of these stood 4 to 4½ feet above the surrounding bottom. The most westerly one was marked by a spar buoy with red and black horizontal stripes, and the most easterly one by a red-and-black flag.

While weather was such that small boats could not be used, the steamer was allowed to drift in various directions at random with the sweep rod hung overboard. Another rock was discovered in this way close to the chart course but as it had $18\frac{6}{10}$ feet over it, with surrounding depths of $21\frac{5}{10}$ feet, it was not marked.

	Feet.
Any one of these three rocks might have been struck by the *Oades* under the conditions existing on October 16. She drew	14
Water surface was below chart datum	3
Under 12-mile speed boat would probably "squat"	1
In storm and sea of that day it might surge	1
Hence draft of boat below chart datum might have been	19

It is hardly reasonable to suppose, however, that such damage could arise from striking any one of these rocks. While the captain gives his course with such certainty, it is quite within reason to suppose that in searching for his consort where chart shows plenty of water he did not pay much attention to a true course after he had passed Starve Island. Looking from abreast of Starve Island Buoy, the 11-foot reef shows clear to the southward of Kelley Island, and I feel convinced it is what he struck. The fact that we have three distinctly different descriptions of his location indicates the truth of the above.

However that may be, in the light of the results of search over so small an area I am far from asserting that there may not be very many other rocks or reefs in the vast area we did not touch, some of which may be worse than the three rocks found. I hardly think, however, that any other so serious as the 11-foot reef exists in that vicinity.

The examinations mentioned above consumed the greater part of three weeks, as much bad weather was experienced, so that in the absence of definite data from which to start I did not feel justified in continuing longer.

I would also report that the 16-foot shoal, shown in red on the chart sent you from Washington, just east of the 11-foot reef, does not exist. It was probably the approximate location of that found, based upon indefinite reports.

As to the rock east of Kelley Island, whose approximate location was shown in red on the chart mentioned, I began a search for that, but the very great discrepancies in the descriptions given made it unwise to more than casually examine the locality. Sounding and sweeping about the location at random for about a mile diameter developed not the slightest indication of any shoal. I expect soon to be able to visit the place in company with Captain Shepard, of Huron, who insists most positively that he found the rock, though not sure that he can find it again. The various notes I have been able to obtain give color to the belief that there is an obstruction of some kind in that vicinity.

Accompanying this report is the chart sent you from Washington, upon which I have platted the rocks found and area swept; also a table giving the sextant angles at the rocks and at the west end of area swept. By these angles each location can be reproduced within less than 10 feet.

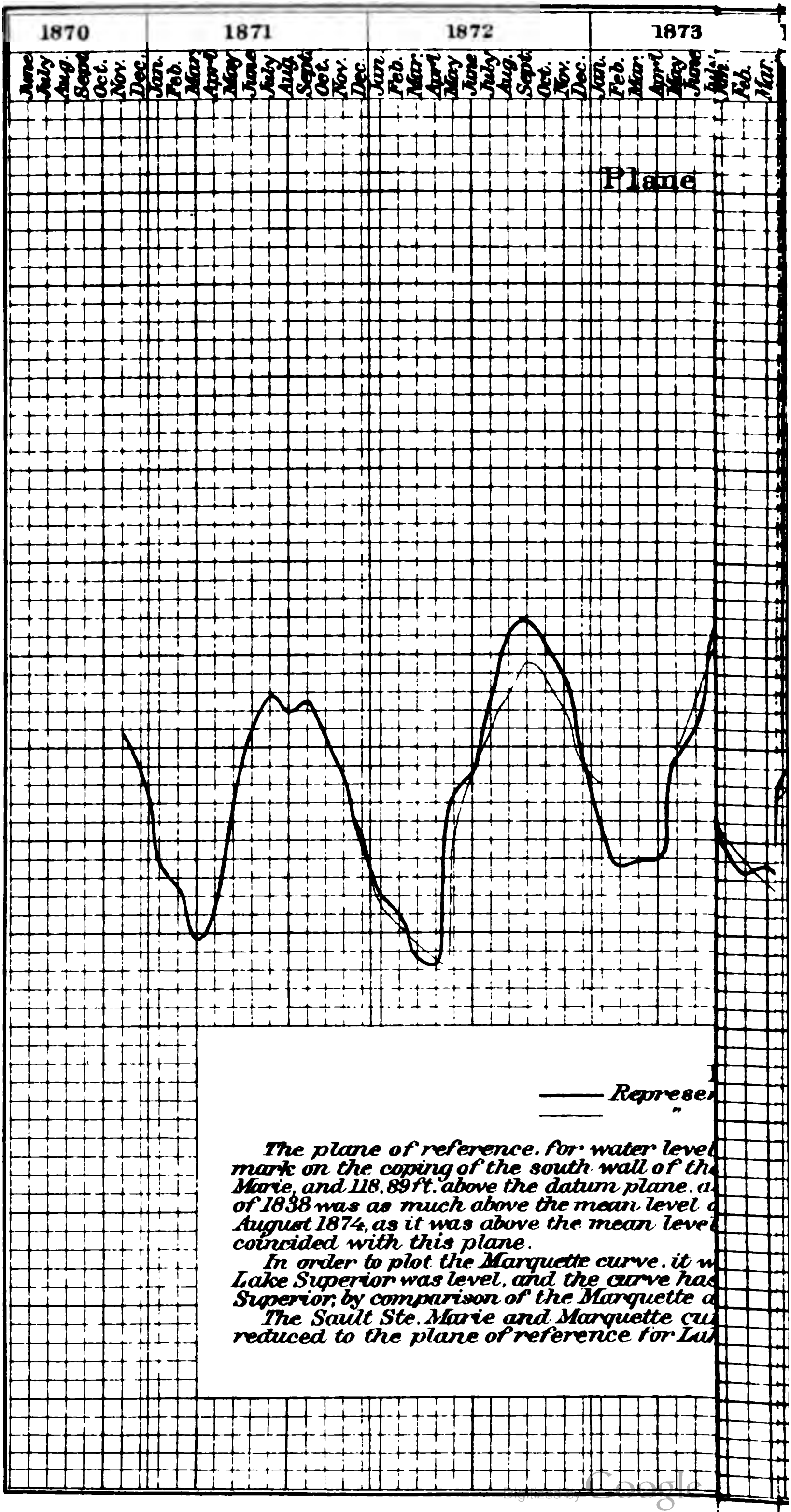
I beg leave to call attention to the fact that the existence of such important obstructions in waters hitherto considered clear indicates that the South Passage should be avoided by deeply laden vessels, especially in heavy westerly winds. Many of these bowlders could be easily buried by a dredge or scattered by dynamite, and it may be well to consider the advisabilty of a systematic and conclusive search over the main passage with a view to clearing it up.

Very respectfully,

WM. T. BLUNT, *Assistant Engineer.*

Lieut. Col. JARED A. SMITH,
Corps of Engineers, U. S. A.

4



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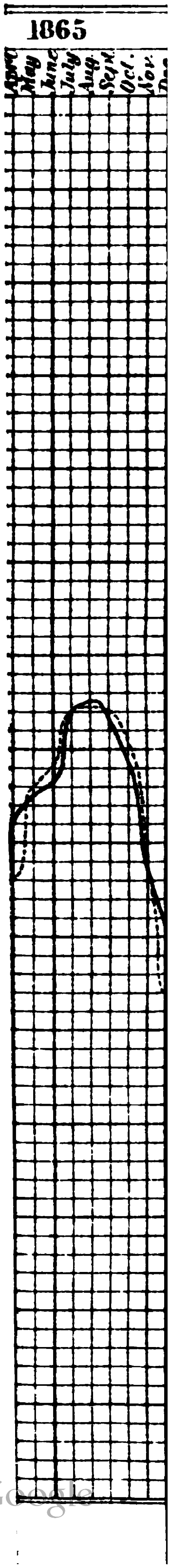
——— *"*

The plane of reference. for water level
mark on the coping of the south wall of th
Marie, and 118.89 ft. above the datum plane. a
of 1838 was as much above the mean level
August 1874, as it was above the mean level
coincided with this plane.

In order to plot the Marquette curve. it w
Lake Superior was level, and the curve has
Superior, by comparison of the Marquette a

The Sault Ste. Marie and Marquette cu
reduced to the plane of reference for La

3



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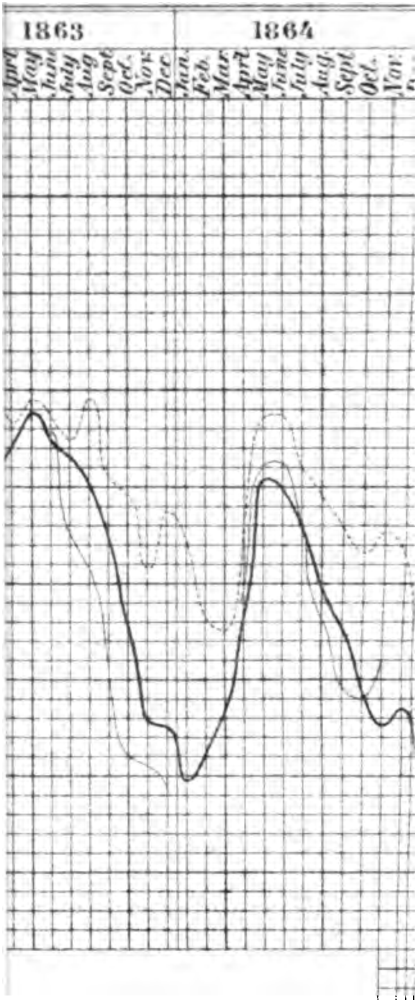

below the bench mark on
with the River Cuyahoga
. High Water of 1838 coincided

assumed that during June
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July and August 1875.
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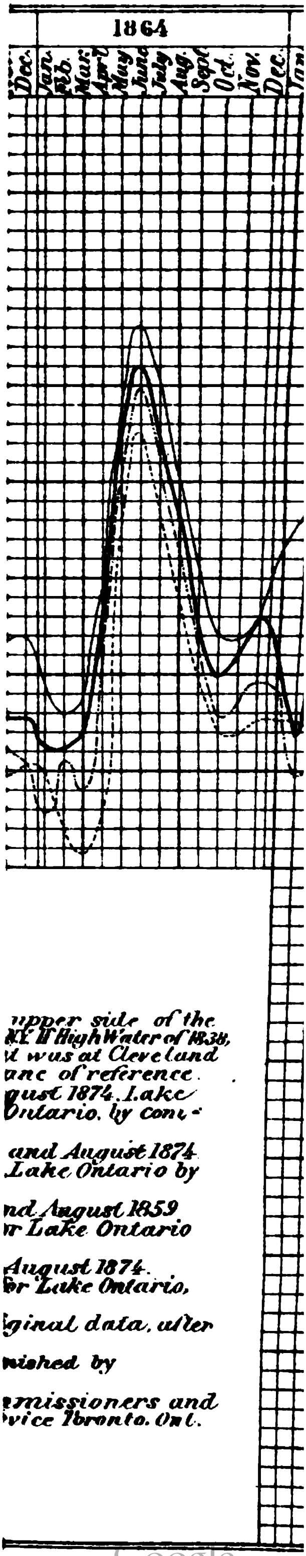
data after being reduced

urnished by E. V. Bodwell


1864
Dec.
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N.L. W High Water of 1838,
d was at Cleveland
ane of reference.
gust 1874. Lake
Ontario. by con-
and August 1874
Lake Ontario by
nd August 1859
r Lake Ontario
August 1874.
r Lake Ontario,
ginal data, after
nished by
missioners and
vice Toronto. Ont.

for obstructions in South Channel—Sextant angles at reef, rocks, and location flag.

	Eleven-foot reef.		West rock, 17$\frac{3}{10}$.		East rock, 17$\frac{1}{10}$.		South rock, 18$\frac{3}{10}$.		Location flag.	
	°	′	°	′	°	′	°	′	°	′
Mouse Island										
	36	07	39	26	a 36	34	36	41	40	35
South Bass Island										
	53	20	52	31	50	41	49	17	52	30
allast Island										
	47	58	44	25	45	58	42	54	43	38
iddle Island										
	22	53	21	59	19	46	18	49	22	00
Kelley Island										
	44	43	39	04	44	26	39	18	37	36
Kelley Island										
	41	15	40	24	43	30	42	42	39	45
Light-house										
	113	44	122	11	a 119	10	130	19	123	56
, Mouse Island										
d Light-house										
	20	24	.....		.....		.....		.....	
Dock										
	94	30	.....		.....		.....		.....	
, Mouse Island										

a South edge.

Money statement.

Appropriation for "Survey of northern and northwestern lakes."

for examination of shoals in Lake Erie:	
y 1, 1896, balance unexpended	$750.00
e 30, 1897, amount expended during fiscal year	750.00

C C C 4.

AL WATER LEVELS OF THE NORTHERN AND NORTHWESTERN LAKES.

daily observations were made at Charlotte and at Oswego, N. Y.,
ake Ontario, from July 1, 1896, to June 30, 1897; at Erie Harbor,
sylvania, Ashtabula and Cleveland, Ohio, and Monroe, Mich, on
Erie; at Milwaukee, Wis., on Lake Michigan, and at Escanaba,
., on Green Bay, from July 1 to November 30, 1896, and from May
June 30, 1897.

ily observations were made at Sand Beach, Mich., on Lake Huron,
at Sault Ste. Marie and Marquette, Mich., on Lake Superior, from
1, 1896, to June 30, 1897.

e accompanying table is a continuation of that published in the
ual Report of the Chief of Engineers for 1896, part 6, page 4067.
e accompanying plates are continuations of those published in the
ual Report of the Chief of Engineers for 1892.

hly mean of water levels for the several stations below the planes of reference adopted in 1876.

Station.	1896.						1897.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
lotte	3.98	4.22	4.01	4.81	4.88	5.13	5.27	5.26	4.72	4.15	3.59	3.42
ego	4.02	4.16	4.64	4.87	5.13	5.13	5.22	5.28	4.78	4.14	3.70	3.48
	3.15	2.95	3.36	3.55	3.74	3.82	3.58	3.72	3.25	2.85	2.40	2.36
abula	3.18	3.00	3.38	3.56	3.80	3.86	3.79	3.80	3.34	2.85	2.48	2.39
eland	3.30	3.09	3.41	3.65	4.02	3.99	4.02	3.82	3.45	2.90	2.57	2.47
roe	2.93	2.87	3.20	3.41	3.90	3.84	4.10	3.72	3.32	2.69	2.46	2.25
vaukee	4.90	4.97	5.07	5.12	5.34	5.39	5.40	5.32	5.01	4.84	4.35	4.08
naba	4.98	4.95	5.11	5.31	5.41	.....	.....	.....	.....	.....	4.59	4.19
Beach	4.81	4.77	4.95	5.15	5.29	5.41	5.83	5.49	5.28	4.94	4.37	4.15
quette	2.22	2.20	2.37	2.69	2.62	2.77	2.93	3.16	3.24	3.21	2.87	2.54
Ste. Marie	2.23	2.21	2.35	2.77	2.76	2.81	3.04	3.35	3.33	3.19	2.85	2.49

WATER LEVEL OF LAKE ERIE.

REPORT OF COL. JARED A. SMITH, CORPS OF ENGINEERS, FOR TH FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, July 26, 1897.

GENERAL: I have the honor to forward herewith record of wate levels on Lake Erie for the fiscal year ending June 30, 1897.

The records were taken at the light-house, Monroe, Mich., and in th harbors at Cleveland and Ashtabula, Ohio, and Erie, Pa.

Very respectfully, your obedient servant,

JARED A. SMITH,
Colonel, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

WATER LEVEL OBSERVATIONS FOR LAKE ERIE FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

Monthly mean water levels for Monroe, Cleveland, Ashtabula, and Erie harbors, expressed in feet below the plane of reference adopted in 1876, that plane being the surface of high water of 1838, and 2.3 feet above the mean level, 1860 to 1875, inclusive:

Stations.	1896.						1897.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Fe*
Monroe, Mich	2.93	2.87	3.20	3.41	3.90	3.84	4.10	3.72	3.32	2.69	2.46	2.3
Cleveland, Ohio	3.30	3.09	3.41	3.65	4.02	3.99	4.02	3.82	3.45	2.90	2.57	2.4
Ashtabula, Ohio	3.18	3.00	3.38	3.56	3.80	3.86	3.79	3.80	3.34	2.85	2.48	2.3
Erie, Pa	3.15	2.95	3.36	3.35	3.74	3.82	3.58	3.72	3.25	3.85	2.40	2.3

WATER LEVEL OF LAKE ONTARIO.

REPORT OF MAJ. WILLIAM S. STANTON, CORPS OF ENGINEERS, FOR TH FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 28, 1897.

GENERAL: In compliance with letter of July 26, 1897, from your office, I have the honor to transmit herewith, in duplicate, the monthly means of the water levels of Lake Ontario at Charlotte and Oswego, reduced to the United States Lake Survey plane of reference for Lake Ontario.

Very respectfully, your obedient servant,

W. S. STANTON,
Major, Corps of Engineers, U. S. A.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

Monthly mean of water levels of Lake Ontario below the plane of reference in 1876, which is 4.98 feet above the zero of the gauge at Oswego.

Stations.	1896.						1897.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Charlotte	3.98	4.22	4.61	4.81	4.88	5.13	5.27	5.26	4.72	4.15	3.59	3.42
Oswego	4.02	4.16	4.64	4.87	5.13	5.13	5.22	5.28	4.78	4.14	3.70	3.48

WATER LEVEL FOR LAKE SUPERIOR.

REPORT OF MAJ. CLINTON B. SEARS, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
Duluth, Minn., July 19, 1897.

GENERAL: I have the honor to submit the following monthly means of Lake Superior water levels at Marquette, Mich., below plane of reference adopted by the United States Lake Survey in 1876 for the fiscal year ending June 30, 1897.

Very respectfully,

CLINTON B. SEARS,
Major, Corps of Engineers, U. S. A.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

Monthly mean of water levels for Lake Superior at Marquette, Mich., below the plane of reference adopted by the United States Lake Survey in 1876, for the fiscal year ending June 30, 1897.

Station.	1896.						1897.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Marquette, Mich	2.22	2.20	2.37	2.69	2.62	2.77	2.93	3.16	3.24	3.21	2.87	2.54

WATER LEVEL OF LAKE MICHIGAN.

REPORT OF CAPT. GEORGE A. ZINN, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
Milwaukee, Wis., July 8, 1897.

GENERAL: I have the honor to transmit herewith diagram* showing water level of Lake Michigan at Milwaukee, Wis., and Escanaba, Mich., for the fiscal year ending June 30, 1897, and table of monthly means.

* * * * * * *

The reductions to plane of reference are:

	Feet.
For Milwaukee	—0.61
For Escanaba	—0.80

Very respectfully, your obedient servant,

GEO. A. ZINN,
Captain, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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*Omitted.

Monthly mean of water levels for the stations given, below the plane of reference adopted in 1876.

Stations.	1896.						1897.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Milwaukee, Wis	4.90	4.97	5.07	5.12	5.34	5.39	5.40	5.32	5.01	4.84	4.35	4.06
Escanaba, Mich	4.98	4.95	5.11	5.31	5.41	(a)	(a)	(a)	(a)	(a)	4.59	4.19

a Bay frozen over.

APPENDIX D D D.

EXPLORATIONS AND SURVEYS IN MILITARY DEPARTMENTS.

D D D 1.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF THE MISSOURI.

ANNUAL REPORT OF MAJ. WILLIAM L. MARSHALL, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

UNITED STATES ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF THE MISSOURI,
Chicago, Ill., July 14, 1897.

SIR: I have the honor to submit the following report as engineer officer of this department for the year ending June 30, 1897.

No field work has been done during the year. The office force has consisted of one clerk, Frederick A. Petersen, who has acted as draftsman also.

The office work has consisted in the preparation of maps and drawings, tracings, reproductions, etc., for the use of the Department Commander and the other officers connected with these headquarters. Also in the issuing of instruments and other articles of engineer property to the officers at the posts in the department, to be used in surveying work and on reconnaissances and marches of the troops.

In compliance with a letter from the War Department of date December 2, 1895, work was commenced in preparing a map of the country embraced in this department. For this purpose it was divided into an eastern and western half, the former comprising Wisconsin, Michigan, Illinois, and Indiana, while the latter consisted of Missouri, Kansas, Arkansas, Oklahoma and Indian Territories. Each half was divided into 50-mile squares, numbered for facility in reference from unity upward. The resulting sheets were 25 inches square and filled in from the General Land Office maps and other available sources.

Thus six sheets of the country around Forts Leavenworth and Riley, Kans., were prepared and sent out in 1896 for revision and completion, while later in the year and during the winter four sheets of the country around Forts Brady and Wayne, Mich., were being prepared to be forwarded to these posts in the spring of 1897 for the necessary revision. On April 7, 1897, however, a confidential communication was issued from the War Department, Adjutant-General's Office, Military Information Division, in which new instructions were given for the guidance of the department commanders in the preparation of a progressive military map. These instructions necessitated that all the work done in this department had to be abandoned and a new system introduced.

This last work has progressed quite slowly for various reasons. Chief among them is the fact that there is only one clerk in the engineer office, who can not give all his time to this map work, for the reason that there is always current work of a various nature which has to be attended to.

Several tracings were made for reproduction and 185 blue prints were taken from these for distribution among the officers of the department. Mounted 12 maps for officers at these headquarters.

Very respectfully, your obedient servant,

W. L. MARSHALL,
Major, Corps of Engineers, U. S. A.,
Engineer Officer, Department of the Missouri.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

D D D 2.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF THE COLUMBIA.

REPORT OF MAJ. THOMAS H. BARRY, ASSISTANT ADJUTANT-GENERAL, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF THE COLUMBIA,
Vancouver Barracks, Wash., July 13, 1897.

SIR: I have the honor to submit the following report of the official transactions of this office for the fiscal year ending June 30, 1897:

PERSONNEL.

This office was in charge of First Lieut. John L. Sehon, Twentieth Infantry, A. D. C., until May 8, 1897, when he was relieved pursuant to General Orders No. 12, current series, headquarters Department of the Columbia.

C. A. Homan, civil-service clerk, has remained on duty in this office throughout the year.

FIELD WORK.

Survey levels and grade stakes for a quarter-mile race track for athletic purposes at Vancouver Barracks.

Minor surveys for the improvement of the water, sewerage, and drainage systems at Vancouver Barracks.

OFFICE WORK.

In compliance with request dated office of the Chief of Engineers, United States Army, August 22, 1896, a map of the Department of the Columbia, revised to date from the latest railway guides, Land Office surveys, and the best attainable compilations in this office, was forwarded to the Chief of Engineers, United States Army, September 25, 1896.

Three hundred copies of the new (fifth) edition of the military map of this department were received January 4, 1897, and are being issued as called for.

A map showing the definite location of the Spokane Falls and Northern Railway from Spokane to the international boundary has been compiled on a scale of 2 miles to 1 inch from maps and data loaned by the chief engineer of the Spokane Falls and Northern Railway.

Twenty-three tracings of figures and apparatus for the illustration of cavalry gymnastics, with blue prints of same, were made.

A large portion of the year was given to the projection and compilation of sheets of the "military progressive department map" as outlined and directed by letter dated War Department, Adjutant-General's Office, Washington, December 2, 1895, with tracings and blue prints for issue to officers detailed for topographical work.

Revised instructions, with details and models for the preparation of the sheets of the "progressive military map of the United States," were received April 20, 1897. New projections, skeleton tracings, and blue prints of the sheets assigned to this department for the season of 1897 are being prepared for issue to the topographical officers.

Various reports referred to this office for information and action and miscellaneous work as follows:

Twenty maps and plans, drawn by hand; 43 tracings made; 553 blue prints made; 24 maps mounted on muslin; 90 department maps issued.

There are no funds available for the use of this office.

Very respectfully,

THOMAS H. BARRY,
Assistant Adjutant-General, Engineer Officer.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

D D D 3.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF CALIFORNIA.

ANNUAL REPORT OF LIEUT. J. D. MILEY, FIFTH ARTILLERY, FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF CALIFORNIA,
San Francisco, Cal., July 7, 1897.

SIR: I have the honor to submit the following report of operations in this office for the fiscal year ending June 30, 1897:

First Lieut. J. F. Reynolds Landis, First Cavalry, aid, was (under paragraph 3, General Orders No. 15, dated headquarters Department of California, June 4, 1895) acting as engineer officer until relieved by me under General Orders, No. 17, current series, headquarters Department of California, June 14, 1897.

C. Winstanley, clerk, has been continuously on duty in the office as topographer and draftsman.

The energies of the office have been almost exclusively directed to carrying out the instructions from the Adjutant-General of the Army of December 1, 1895, and numerous sheets were prepared thereunder until the receipt of the revised instructions, dated April 7, 1897, when all work on the former map and sheets was abandoned and a new index map was at once prepared, the sheets corresponding in area and number with those of the index map on file in this office.

Polyconic projections, for sheets, in accordance with these instructions were at once prepared, but owing to the lack of reliable maps, showing wagon roads and the other information that was called for on the skeleton sheets to be prepared in the office, but little progress has yet been made in completing them.

Wheeler's surveys west of the one hundredth meridian did not afford us any information of the desired portion, neither did the United States

Coast and Geodetic Survey, except in the immediate neighborhood of harbors. Several very useful sheets were found in the United States Geological Survey, but the lake survey did not assist us, being too remote from this department.

Four maps have been purchased for the use of this office from the contingent fund by the adjutant-general of the department, one of the neighborhood of San Francisco Bay, one of the southern part of the State, one of Contra Costa County, and one of Marin County, the last two being on a large scale. From these much valuable information can be derived.

From the excess of acid used in its preparation, black-print paper, when kept in rolls ready sensitized, quickly deteriorates and becomes very brittle. To obviate this I have made arrangements to sensitize my own paper, as required, and print the sheets at once. By this means I hope to get better results and prints that can be handled without breaking the paper.

By an act of the California legislature, approved March 9, 1897, the State granted and released to the Federal Government certain pieces or parcels of land extending 300 yards out beyond low-water mark, adjoining all military reservations bordering on tidal water, maps of all such reservations and the land added thereto to be placed on file in the office of the recorder of deeds of the county in which the reservation might be situated, and also in the office of the surveyor-general of the State. In consequence, maps of a convenient size were prepared and transmitted to the adjutant-general of the department of the Presidio of San Francisco, Fort Mason, Alcatraz, and Angel Islands, Benicia Arsenal and Barracks, and San Diego Barracks.

Lieut. Milton F. Davis, Fourth Cavalry, prepared a very comprehensive map of the Sequoia and General Grant national parks, the topography and information contained in which will be transferred to the sheets of the military information department map as soon as that portion is reached. This remark also applies to a map of the Yosemite National Park, prepared by Lieut. Harry C. Benson, of the same regiment, several copies of which have been supplied to the cavalry troop now patrolling the park. Copies have also been furnished to the deputy United States surveyor (Campbell), who is about to resurvey the boundaries and set suitable monuments.

Very respectfully,

J. D. MILEY,
First Lieut., Fifth Artillery,
Acting Engineer Officer.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

D D D 4.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF THE COLORADO.

ANNUAL REPORT OF LIEUT. JOHN L. SEHON, TWENTIETH INFANTRY, A. D. C., FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF THE COLORADO,
Denver, Colo., July 27, 1897.

SIR: I have the honor to submit the following report of the official transactions of this office for the period covered from September 1, 1896 (date of last report), to June 30, 1897.

PERSONNEL.

First Lieut. George T. Langhorne, First Cavalry, aid-de-camp, remained in charge of the office since submitting last report until May 8, 1897.

First Lieut. John L. Sehon, Twentieth Infantry, aid-de-camp, in compliance with General Orders, No. 12, headquarters Department of the Colorado, May 24, 1897, assumed charge of the office June 8, 1897, relieving Second Lieut. J. B. Bennet, Seventh Infantry, detailed to perform the duty until the arrival at these headquarters of an officer of the personal staff of Brig. Gen. E. S. Otis, United States Army, the present department commander.

Mr. Charles Kern. an efficient topographer and draftsman, has continued on duty in the office as assistant to the engineer officer.

OFFICE WORK.

Excellent work has been done on the progressive military map, the section cards returned to this office from the several detachments now engaged in the field revision of the same indicating that more satisfactory results will be attained under the system recently adopted than obtained under the method followed when the scheme was first instituted.

No map of the Department of the Colorado has ever been prepared since the organization of the department with the present territorial limits, a substitute for such being had in general land office maps of the States of Colorado and Utah and Territories of New Mexico and Arizona obtained from the Interior Department, but these can not be secured in sufficient numbers to permit a general distribution to all officers serving at posts in the department who may desire them.

With a view to surmounting this deficiency, it is the intention to commence at the first opportunity a drawing for the production of a map of this military department containing all attainable information, but with the services of only one draftsman available in the office, progress upon such a work will necessarily be slow.

One hundred and fifty-five maps of portions of this department have been issued, 15 maps drawn by hand, 36 tracings made, 208 solar prints of different maps made, 51 maps mounted on muslin, and 188 maps mounted on cardboard.

Some miscellaneous work has been done in addition to the foregoing, and numerous verbal reports to the department commander and adjutant-general of the department made at various times.

No funds have been available for the use of this office during the year, a few necessary materials and some requisite articles of office, equipment having been furnished by the quartermaster's department.

Very respectfully, your obedient servant,

John L. Sehon,
First Lieutenant, Twentieth Infantry,
Aid-de-Camp, Engineer Officer.

Brig. Gen. John M. Wilson,
Chief of Engineers, U. S. A.

APPENDIX E E E.

LAWS FOR PROTECTION OF NAVIGABLE WATERS.

[Printed in House Doc. No. 293, Fifty-fourth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., February 10, 1897.

SIR: Section 2 of the river and harbor act of June 3, 1896, directs the Secretary of War "to cause to be prepared a compilation of all general laws that have been enacted from time to time by Congress for the maintenance, protection, and preservation of the navigable waters of the United States which are now in force, and to submit the same to Congress" at its present session, "together with such recommendation as to revision, emendation, or enlargement of the said laws as, in his judgment, will be advantageous to the public interest."

In pursuance of the foregoing provision of the act, I have the honor to submit herewith (1) a compilation of the general laws relating to the maintenance, preservation, and protection of navigable waters of the United States now in force, and (2) a draft of an act embodying such revision and enlargement of the aforesaid laws as the experience of this office has shown to be advantageous to the public interest.

The draft submitted covers every subject embraced in the existing laws, together with some additional subjects, except those authorizing the Secretary of War to make regulations for the navigation of Government canals and for the opening of drawbridges, which are comprehended in sections 4 and 5, respectively, of the act of August 18, 1894. These two laws have been omitted for the reasons that they appear unobjectionable in their present form; regulations under their provisions have been prescribed with much care and published at much expense; their force and constitutionality have been sustained by the courts, and no public advantage could be obtained by any change in their provisions.

Much care has been given by this office to the preparation of the draft submitted, and the views of some of the most experienced officers of the Corps of Engineers have been invited and considered in connection therewith. It is believed to be clear and free from ambiguity, and better adapted to conserve the important interests of commerce and navigation than the laws in their present form.

As the Secretary of War has given personal consideration to the question of changing the existing law relating to the removal of wrecks, special care has been exercised in the revision of the law on that subject, which will be found in sections 11 and 12 of the draft submitted.

In this connection attention is respectfully invited to a separate paper* containing a draft of a law for the removal of wrecks, which, it is understood, accords with the views of the Philadelphia Maritime Exchange. This, however, differs but little from the draft adopted by this office.

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* Not printed.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig Gen., Chief of Engineers, U. S. Army.

Hon. DANIEL S. LAMONT,
Secretary of War.

COMPILATION OF EXISTING LAWS RELATING TO THE PROTECTION, PRESERVATION, AND MAINTENANCE OF THE NAVIGABLE WATERS OF THE UNITED STATES.

Bridges injuring channels or banks of rivers.—Whenever complaint shall be made to the Secretary of War that by reason of the placing in any navigable waters of the United States of any bridge pier or abutment, the current of such waters has been so deflected from its natural course as to cause by producing caving of banks or otherwise serious damage or danger to property, it shall be his duty to make inquiry, and if it shall be ascertained that the complaint is well founded, he shall cause the owners or persons operating such bridge to repair such damage or prevent such danger to property by such means as he shall indicate and within such time as he may name, and in default thereof the owners or persons operating such bridge shall be liable in any court of competent jurisdiction to the persons injured in a sum double the amount of said injury. * * * (Sec. 2, river and harbor act of August 11, 1888.)

Removal of wrecks.—Whenever hereafter the navigation of any river, lake, harbor, or bay, or other navigable water of the United States, shall be obstructed or endangered by any sunken vessel or water-craft, it shall be the duty of the Secretary of War, upon satisfactory information thereof, to cause reasonable notice, of not less than thirty days, to be given, personally or by publication, at least once a week in the newspaper published nearest the locality of such sunken vessel or craft, to all persons interested in such vessel or craft, or in the cargo thereof, of the purpose of said Secretary, unless such vessel or craft shall be removed as soon thereafter as practicable by the parties interested therein, to cause the same to be removed. If such sunken vessel or craft and cargo shall not be removed by the parties interested therein as soon as practicable after the date of the giving of such notice by publication, or after such personal service of notice, as the case may be, such sunken vessel or craft shall be treated as abandoned and derelict, and the Secretary of War shall proceed to remove the same. Such sunken vessel or craft and cargo and all property therein when so removed shall, after reasonable notice of the time and place of sale, be sold to the highest bidder or bidders for cash, and the proceeds of such sales shall be deposited in the Treasury of the United States to the credit of a fund for the removal of such obstructions to navigation, under the direction of the Secretary of War, and to be paid out for that purpose on his requisition therefor. The provisions of this act shall apply to all such wrecks whether removed under this act or under any other act of Congress. Such sum of money as may be necessary to execute this section of this act is hereby appropriated, out of any money in the Treasury of the United States not otherwise appropriated, to be paid out on the requisition of the Secretary of War. (Sec. 4, river and harbor act of June 14, 1880.)

The power and authority granted to the Secretary of War under and by virtue of section four of the act of Congress approved June fourteenth, eighteen hundred and eighty, relating to wrecks and sunken vessels be, and the same are hereby, enlarged so that the Secretary of War may, in his discretion, sell and dispose of any such sunken craft, vessel, or cargo, or property therein, before the raising or removal thereof, according to the same regulations that are in the said act prescribed for the sale of the same after the removal thereof; and all laws and parts of laws inconsistent herewith are hereby repealed. (River and harbor act of August 2, 1882.)

All wrecks of vessels and other obstructions to the navigation of any port, roadstead, harbor, or navigable river, or other navigable waters of the United States, which may have been permitted by the owners thereof or the parties by whom they were caused to remain to the injury of commerce and navigation for a longer period than two months, shall be subject to be broken up and removed by the Secretary of War, without liability for any damage to the owners of the same. (Sec. 8, river and harbor act of September 19, 1890.)

Bridges obstructing navigation.—Whenever the Secretary of War shall have good reason to believe that any railroad or other bridge now constructed, or which may hereafter be constructed over any of the navigable water-ways of the United States is an unreasonable obstruction to the free navigation of such waters on account of insufficient height, width of span, or otherwise, or where there is difficulty in passing the draw-opening or the drawspan of such bridge by rafts, steam boats, or other water-craft, it shall be the duty of the said Secretary, first giving the parties reasonable opportunity to be heard, to give notice to the persons or corporations owning or controlling such bridge so to alter the same as to render navigation through or under it reasonably free, easy, and unobstructed; and in giving such notice he shall specify the changes required to be made, and shall prescribe in each case a reasonable time in which to make them. If at the end of such time the alteration has not been made, the Secretary of War shall forthwith notify the United States district attorney for the district in which such bridge is situated, to the end that the criminal proceedings mentioned in the succeeding section may be taken.

If the persons, corporation, or association owning or controlling any railroad or other bridge shall, after receiving notice to that effect as hereinbefore required from the Secretary of War and within the time prescribed by him, willfully fail or refuse to remove the same, or to comply with the lawful order of the Secretary of War in the premises such persons, corporation, or association shall be deemed guilty of a misdemeanor and, on conviction thereof, shall be punished by a fine not exceeding five thousand dollars, and every month such persons, corporation, or association shall remain in default in respect to the removal or alteration of such bridge shall be deemed a new offense, and subject the persons, corporation, or association so offending to the penalties above prescribed. (Secs. 4 and 5, river and harbor act of September 19, 1890.)

Construction of piers, bridges, etc.—It shall not be lawful to build any wharf, pier, dolphin, boom, dam, weir, breakwater, bulkhead, jetty, or structure of any kind outside established harbor lines, or in any navigable waters of the United States where no harbor lines are or may be established, without the permission of the Secretary of War, in any port, roadstead, haven, harbor, navigable river, or other waters of the United States, in such manner as shall obstruct or impair navigation, commerce, or anchorage of said waters; and it shall not be lawful hereafter to commence the construction of any bridge, bridge draw, bridge piers, and abutments, causeway, or other works over or in any port, road, roadstead, haven, harbor, navigable river or navigable waters of the United States, under any act of the legislative assembly of any State, until the location and plan of such bridge or other works have been submitted to and approved by the Secretary of War, or to excavate or fill, or in any manner to alter or modify the course, location, condition or capacity of any port, roadstead, haven, harbor, harbor of refuge, or inclosure within the limits of any breakwater, or of the channel of any navigable water of the United States unless approved and authorized by the Secretary of War:

Provided: That this section shall not apply to any bridge, bridge draw, bridge piers, and abutments, the construction of which has been heretofore duly authorized by law, or be so construed as to authorize the construction of any bridge, draw bridge, bridge piers, and abutments, or other works under an act of the legislature of any State, over or in any stream, port, roadstead, haven, or harbor, or other navigable water not wholly within the limits of such State. (Sec. 3, river and harbor act of July 13, 1892.)

Depositing material in navigable waters.—It shall not be lawful to cast, throw, empty, or unlade, or cause, suffer, or procure to be cast, thrown, emptied, or unladen, either from or out of any ship, vessel, lighter, barge, boat, or other craft, or from the shore, pier, wharf, furnace, manufacturing establishments, or mills of any kind whatever, any ballast, stone, slate, gravel, earth, rubbish, wreck, filth, slabs, edgings, sawdust, slag, cinders, ashes, refuse, or other waste of any kind, into any port, road, roadstead, harbor, haven, navigable river, or navigable waters of the United States which shall tend to impede or obstruct navigation, or to deposit or place or cause, suffer, or procure to be deposited or placed, any ballast, stone, slate, gravel, earth, rubbish, wreck, filth, slabs, edgings, sawdust, or other waste in any place or situation on the bank of any navigable waters where the same shall be liable to be washed into such navigable waters, either by ordinary or high tides, or by storms or floods, or otherwise, whereby navigation shall or may be impeded or obstructed: *Provided*, That nothing herein contained shall extend or be construed to extend to the casting out, unlading, or throwing out of any ship or vessel, lighter, barge, boat, or other craft, any stones, rocks, bricks, lime, or other materials used, or to be used, in or toward the building, repairing, or keeping in repair any quay, pier, wharf, weir, bridge, building, or other work lawfully erected or to be erected on the banks or sides of any port, harbor, haven, channel, or navigable river, or to the casting out, unlading, or depositing of any material excavated for the improvement of navigable waters, into such places and in such manner as may be deemed by the United States officer supervising said improvement most judicious and practicable and for the best interests of such improvements, or to prevent the depositing of any substance above mentioned under a permit from the Secretary of War, which he is hereby authorized to grant, in any place designated by him where navigation will not be obstructed thereby. (Sec. 6, river and harbor act of September 19, 1890.)

It shall not be lawful to place, discharge, or deposit, by any process or in any manner, ballast, refuse, dirt, ashes, cinders, mud, sand, dredgings, sludge, acid, or any other matter of any kind other than that flowing from streets, sewers, and passing therefrom in a liquid state, in the waters of any harbor or river of the United States, for the improvement of which money has been appropriated by Congress, elsewhere than within the limits defined and permitted by the Secretary of War; neither shall it be lawful for any person or persons to move, destroy, or injure in any manner whatever any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States, in whole or in part, for the preservation and improvement of any of its navigable waters, or to prevent floods, or as boundary marks, tide gauges, surveying stations, buoys, or other established marks; any and every such act is made a misdemeanor, and every person knowingly engaged in, or who shall knowingly aid, abet, authorize, or instigate a violation of this section shall, upon conviction, be punishable by fine or imprisonment, or both, such fine to be not less than two hundred and fifty dollars nor more than twenty-five hundred dollars, and the imprisonment to be not less than thirty days nor more than one year, either or both united, as the judge before whom conviction is obtained shall decide, one-half of said fine to be paid to the person or persons giving information which shall lead to conviction of this misdemeanor. (Sec. 6, river and harbor act of August 18, 1894.)

Any and every master, pilot, and engineer, or person or persons acting in such capacity, respectively, on board of any boat or vessel who may willfully injure or destroy any work of the United States contemplated in section six of this Act, or who shall knowingly engage in towing any scow, boat, or vessel loaded with any such prohibited matter to any point or place of deposit, or discharge in any harbor contemplated in section six of this Act, elsewhere than within the limits defined and permitted by the Secretary of War, shall be deemed guilty of a violation of this Act and shall, upon conviction, be punishable as hereinbefore provided for offenses in violation of section six of this Act, and shall also have his license revoked or suspended for a term to be fixed by the judge before whom tried and convicted.

Any boat, vessel, scow, or other craft used or employed in violating any of the provisions of sections six and seven of this Act shall be liable to the pecuniary penalties imposed thereby, and in addition thereto to the amount of the damages done by said boat, vessel, scow, or other craft, which latter sum shall be placed to the credit of the appropriation for the improvement of the harbor in which the damage occurred, and said boat, vessel, scow, or other craft may be proceeded against summarily by way of libel in any district court of the United States having jurisdiction thereof. (Secs. 7 and 8, river and harbor act of August 18, 1894.)

Unlawful obstructions forbidden and penalties prescribed.—The creation of any obstruction, not affirmatively authorized by law, to the navigable capacity of any waters, in respect of which the United States has jurisdiction, is hereby prohibited. The continuance of any such obstruction, except bridges, piers, docks and wharves, and similar structures erected for business purposes, whether heretofore or hereafter created, shall constitute an offense, and each week's continuance of any such obstruction shall be deemed a separate offense. Every person and every corporation which shall be guilty of creating or continuing any such unlawful obstruction in this act mentioned [act of September 19, 1890], or who shall violate the provisions of the last four preceding sections of this act [sections 6, 7, 8, and 9], shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding five thousand dollars, or by imprisonment (in the case of a natural person) not exceeding one year, or by both such punishments, in the discretion of the court; the creating or continuing of any unlawful obstruction in this act mentioned may be prevented and such obstruction may be caused to be removed by the injunction of any circuit court exercising jurisdiction in any district in which such obstruction may be threatened or may exist; and proper proceedings in equity to this end may be instituted under the direction of the Attorney-General of the United States. (Sec. 10, river and harbor act of September 19, 1890.)

Method of enforcing laws forbidding obstructions to navigation.—It shall be the duty of officers and agents having the supervision, on the part of the United States, of the works in progress for the preservation and improvement of said navigable waters, and, in their absence, of the United States collectors of customs and other revenue officers to enforce the provisions of this act by giving information to the district attorney of the United States for the district in which any violation of any provision of this act shall have been committed. * * * (Sec. 11, river and harbor act of September 19, 1890.)

Injuries to Government piers, etc.—It shall not be lawful for any person or persons to take possession of or make use for any exclusive purpose, or build upon, alter, deface, destroy, injure, obstruct, or in any other manner impair the usefulness of any sea-wall, bulkhead, jetty, dike, levee, wharf, pier or other work built by the United States in whole or in part, for the preservation and improvement of any of its navigable waters, or to prevent floods, or as boundary marks, tide-gauges, surveying stations, buoys, or other established marks, nor remove for ballast or other purposes any stone or other material composing such works. (Sec. 9, river and harbor act of September 19, 1890.)

Harbor lines.—Where it is made manifest to the Secretary of War that the establishment of harbor-lines is essential to the preservation and protection of harbors, he may, and is hereby authorized, to cause such lines to be established, beyond which no piers, wharves, bulk-heads, or other works shall be extended or deposits made, except under such regulations as may be prescribed from time to time by him; and any person who shall willfully violate the provisions of this section or any rule or regulation made by the Secretary of War in pursuance of this section, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, at the discretion of the court for each offense. (Sec. 12, river and harbor act of September 19, 1890; see also sec. 12, river and harbor act of August 11, 1888.)

No money appropriated for the improvement of rivers and harbors in this act or hereafter shall be expended for dredging inside of harbor lines duly established. (Sec. 5, river and harbor act of July 13, 1892.)

Whenever the Secretary of War grants to any person or persons permission to extend piers, wharves, bulkheads, or other works, or to make deposits in any tidal harbor or river of the United States beyond any harbor lines established under authority of the United States, he shall cause to be ascertained the amount of tide water displaced by any such structure or by any such deposits, and he shall, if he deem it necessary, require the parties to whom the permission is given to make compensation for such displacement either by excavating in some part of the harbor, including tide-water channels between high and low water mark, to such an extent as to create a basin for as much tide water as may be displaced by such structure or by such deposits, or in any other mode that may be satisfactory to him. * * * (Sec. 9, river and harbor act of August 18, 1894.)

Opening of drawbridges.—It shall be the duty of all persons owning, operating, and tending the drawbridges now built or which may hereafter be built across the navigable rivers and other waters of the United States, to open, or cause to be opened, the draws of such bridges under such rules and regulations as in the opinion of the Secretary of War the public interests require to govern the opening of drawbridges for the passage of vessels and other water crafts, and such rules and regulations, when so made and published, shall have the force of law. Every such person who shall willfully fail or refuse to open, or cause to be opened, the draw of any such bridge for the passage of a boat or boats, or who shall unreasonably delay the opening of said draw after reasonable signal shall have been given, as provided in such regulations, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not more than two thousand dollars nor less than one thousand dollars, or by imprisonment (in the case of a natural person) for not exceeding one year, or by both such fine and imprisonment, in the discretion of the court: *Provided*, That the proper action to enforce the provisions of this section may be commenced before any commissioner, judge, or court of the United States, and such commissioner, judge, or court shall proceed in respect thereto as authorized by law in case of crimes against the United States: *Provided further*, That whenever, in the opinion of the Secretary of War, the public interests require it, he may make rules and regulations to govern the opening of drawbridges for the passage of vessels and other water crafts, and such rules and regulations, when so made and published, shall have the force of law, and any violation thereof shall be punished as hereinbefore provided. (Sec. 5, river and harbor act of August 18, 1894.)

Regulations for canals.—It shall be the duty of the Secretary of War to prescribe such rules and regulations for the use, administration, and navigation of any or all canals and similar works of navigation that now are, or that hereafter may be, owned, operated, or maintained by the United States as in his judgment the public necessity may require.

Such rules and regulations shall be posted, in conspicuous and appropriate places, for the information of the public; and every person and every corporation which shall knowingly and willfully violate such rules and regulations shall be deemed guilty of a misdemeanor and, on conviction thereof in any district court in the United States within whose territorial jurisdiction such offense may have been committed, shall be punished by a fine not exceeding five hundred dollars, or by imprisonment (in the case of a natural person) not exceeding six months, in the discretion of the court. (Sec. 4, river and harbor act of August 18, 1894.)

DRAFT OF PROPOSED ACT REVISING AND ENLARGING LAWS FOR PROTECTION OF NAVIGABLE WATERS.

AN ACT for the preservation, protection, and maintenance of the navigable waters of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall not be lawful to construct or commence the construction of any bridge, dam, dike, or causeway over or in any port, roadstead, haven, harbor, canal, navigable river, or other navigable water of the United States until the consent of Congress to the building of such structures shall have been obtained and until the plans for the same shall have been submitted to and approved by the Chief of Engineers and by the Secretary of War: *Provided*, That such structures may be built under authority of the legislature of a State across rivers and other waterways, the navigable portions of which lie wholly within the limits of a single State, provided the location and plans thereof are submitted to and approved by the Chief of Engineers and by the Secretary of War before construction is commenced: *And provided further*, That when plans for any bridge or other structure have been approved by the Chief of Engineers and by the Secretary of War, it shall not be lawful to deviate from such plans either before or after completion of the structure unless the modification of said plans has previously been submitted to and received the approval of the Chief of Engineers and of the Secretary of War.

SEC. 2. That the creation of any obstruction not affirmatively authorized by law to the navigable capacity of any of the waters of the United States is hereby prohibited. And it shall not be lawful to build or commence the building of any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structures in any port, roadstead, haven, harbor, canal, navigable river, or other water of the United States, outside established harbor lines, or where no harbor lines have been established, except on plans recommended by the Chief of Engineers and authorized by the Secretary of War. And it shall not be lawful to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of any port, roadstead, haven, harbor, canal, lake, harbor of refuge, or inclosure within the limits of any breakwater, or of the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of War prior to beginning the same.

SEC. 3. That where it is made manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of harbors he may, and is hereby authorized to, cause such lines to be established, beyond which no piers, wharves, bulkheads, or other works shall be extended or deposits made, except under such regulations as may be prescribed from time to time by him: *Provided*, That whenever the Secretary of War grants to any person or persons permission to extend piers, wharves, bulkheads, or other works, or to make deposits in any tidal harbor or river of the United States beyond any harbor lines established under authority of the United States, he shall cause to be ascertained the amount of tide water displaced by any such structure or by any such deposits, and he shall, if he deem it necessary, require the parties to whom the permission is given to make compensation for such displacement either by excavating in some part of the harbor, including tide-water channels between high and low water mark, to such an extent as to create a basin for as much tide water as may be displaced by such structure or by such deposits, or in any other mode that may be satisfactory to him.

SEC. 4. That every person and every corporation that shall violate any of the provisions of sections one, two, and three of this act, or any rule or regulation made by the Secretary of War in pursuance of the provisions of the said section three, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding twenty-five hundred dollars nor less than five hundred dollars, or by imprisonment (in the case of a natural person) not exceeding one year, or by both such punishments, in the discretion of the court. And further, the removal of any structures or parts of structures erected in violation of the provisions of the said sections may be enforced by the injunction of any circuit court exercising jurisdiction in any district in which such structures may exist, and proper proceedings to this end may be instituted under the direction of the Attorney-General of the United States.

SEC. 5. That it shall not be lawful to throw, discharge, or deposit, or cause, suffer, or procure to be thrown, discharged, or deposited either from or out of any ship, barge, or other floating craft of any kind, or from the shore, wharf, manufacturing establishment, or mill of any kind, any refuse matter of any kind or description whatever other than that flowing from streets and sewers and passing therefrom in a liquid state, into any navigable water of the United States, or into any tributary of any navigable water from which the same shall float or be washed into such navigable water; and it shall not be lawful to deposit, or cause, suffer, or procure to be deposited material of any kind in any place on the bank of any navigable water, or on the bank of any tributary of any navigable water, where the same shall be liable to be washed into such navigable water, either by ordinary or high tides, or by storms or floods, or otherwise, whereby navigation shall or may be impeded or obstructed: *Provided*, That nothing herein contained shall extend to, apply to, or prohibit the operations in connection with the improvement of navigable waters or construction of public works, considered necessary and proper by the United States officers supervising such improvement or public work: *And provided further*, That the Secretary of War, whenever in the judgment of the Chief of Engineers anchorage and navigation will not be injured thereby, may permit the deposit of any material above mentioned in navigable waters, within limits to be defined and under conditions to be prescribed by him, provided application is made to him prior to depositing such material; and whenever any permit is so granted the conditions thereof shall be strictly complied with, and any violation thereof shall be unlawful.

SEC. 6. That it shall not be lawful for any person or persons to take possession of or make use of for any purpose, or build upon, alter, deface, destroy, move, injure, obstruct by fastening vessels thereto or otherwise, or in any manner whatever impair the usefulness of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States, or any piece of plant, floating or otherwise, used in the construction of such work under the control of the United States, in whole or in part, for the preservation and improvement of any of its navigable waters or to prevent floods, or as boundary marks, tide gauges, surveying stations, buoys, or other established marks, nor remove for ballast or other purposes any stone or other material composing such works: *Provided*, That the Secretary of War may, on the recommendation of the Chief of Engineers, grant permission for the temporary occupation or use of any of the aforementioned public works when in his judgment such occupation or use will not be injurious to the public interest.

SEC. 7. That it shall not be lawful to tie up or anchor vessels or other craft in navigable channels in such a manner as to prevent or obstruct the passage of other vessels or craft; or to voluntary sink vessels or other craft in navigable channels; or to float loose timber and logs, or to float what is known as sack rafts of timber and logs in streams or channels actually navigated by steamboats in such manner as to obstruct, impede, or endanger navigation. And whenever a vessel, raft, or other craft is wrecked and sunk in a navigable channel, accidentally or otherwise, it shall be the duty of the owner of such sunken craft to immediately mark it with a buoy or beacon during the day and a lighted lantern at night, and to maintain such marks until the sunken craft is removed or abandoned, and the neglect or failure of the said owner so to do shall be unlawful; and it shall be the duty of the owner of such sunken craft to commence the immediate removal of the same, and prosecute such removal diligently, and failure to do so shall be considered as an abandonment of such craft, and subject the same to removal by the United States as hereinafter provided for.

SEC. 8. That every person and every corporation that shall violate, or that shall knowingly aid, abet, authorize, or instigate a violation of the provisions of sections five, six, and seven of this act shall be guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding twenty-five hundred dollars nor less than five hundred dollars, or by imprisonment (in the case of a natural person) for not less than thirty days nor more than one year, or by both such fine and imprisonment, in the discretion of the court, one-half of said fine to be paid to the person or persons giving information which shall lead to conviction. And any and every master, pilot, and engineer, or person or persons acting in such capacity, respectively, on board of any boat or vessel who shall knowingly engage in towing any scow, boat, or vessel loaded with any material specified in section five of this act to any point or place of deposit or discharge in any harbor or navigable water, elsewhere than within the limits defined and permitted by the Secretary of War, or who shall willfully injure or destroy any work of the United States contemplated in section six of this act, or who shall willfully obstruct the channel of any waterway in the manner contemplated in section seven of this act, shall be deemed guilty of a violation of this act, and shall upon conviction be punished as hereinbefore provided in this section, and shall also have his license revoked or suspended for a term to be fixed by the judge before whom tried and convicted. And any boat, vessel, scow, raft, or other craft used or employed in violating any of the provisions of sections five, six, and seven of this act shall be liable for the pecuniary penalties specified in this section, and in addition thereto for the amount of the damages done by said boat, vessel, scow, raft, or other craft, which latter sum shall be placed to the credit of the appropriation for the improvement of the harbor or waterway in which the damage occurred, and said boat, vessel, scow, raft, or other craft may be proceeded against summarily by way of libel in any district court of the United States having jurisdiction thereof.

SEC. 9. That the Department of Justice shall conduct the legal proceedings necessary to enforce the foregoing provisions of this act; and it shall be the duty of district attorneys of the United States to vigorously prosecute all offenders against the same whenever requested to do so by the Secretary of War or by any of the officials hereinafter designated, and it shall furthermore be the duty of said district attorneys to report to the Attorney-General of the United States the action taken by him against offenders so reported, and a transcript of such reports shall be transmitted to the Secretary of War by the Attorney-General; and for the better enforcement of the said provisions and to facilitate the detection and bringing to punishment of such offenders, the officers and agents of the United States in charge of river and harbor improvements, and the assistant engineers and inspectors employed under them by authority of the Secretary of War, and the United States collectors of customs and other revenue officers, shall have power and authority to swear out process and to arrest and take into custody, with or without process, any person or persons who may commit any of the acts or offenses prohibited by the foregoing sections of this act, or who may violate any of the provisions of the same: *Provided*, That no person shall be arrested without process for any offense not committed in the presence of some one of the aforesaid officials: *And provided further*, That whenever any arrest is made under the provisions of this act, the person so arrested shall be brought forthwith before a commissioner, judge, or court of the United States for examination of the offenses alleged against him; and such commissioner, judge, or court shall proceed in respect thereto as authorized by law in case of crimes against the United States.

SEC. 10. That whenever the Secretary of War shall have good reason to believe that any railroad or other bridge now constructed, or which may hereafter be constructed, over any of the navigable waterways of the United States is an unreasonable obstruction to the free navigation of such waters on account of insufficient height, width of span, or otherwise, or where there is difficulty in passing the draw opening or the drawspan of such bridge by rafts, steamboats, or other water craft, it shall be the duty of the said Secretary, first giving the parties reasonable opportunity to be heard, to give notice to the persons or corporations owning or controlling such bridge so to alter the same as to render navigation through or under it reasonably free, easy, and unobstructed; and in giving such notice he shall specify the changes recommended by the Chief of Engineers that are required to be made, and shall prescribe in each case a reasonable time in which to make them. If at the end of such time the alteration has not been made, the Secretary of War shall forthwith notify the United States district attorney for the district in which such bridge is situated, to the end that the criminal proceedings hereinafter mentioned may be taken. If the persons, corporation, or association owning or controlling any railroad or other bridge shall, after receiving notice to that effect, as hereinbefore required, from the Secretary of War, and within the time prescribed by him willfully fail or refuse to remove the same, or to comply with the lawful order of the Secretary of War in the premises, such persons, corporation, or association shall be deemed guilty of a misdemeanor and, on conviction thereof shall be punished by a fine not exceeding five thousand dollars, and every month such persons, corporation, or association shall remain in default in respect to the removal or alteration of such bridge shall be deemed a new offense, and subject the persons, corporation, or association so offending to the penalties above prescribed: *Provided*, That in any case arising under the provisions of this section an appeal or writ of error may be taken from the district courts or from the existing circuit courts direct to the Supreme Court either by the United States or by the defendants.

SEC. 11. That whenever the navigation of any river, lake, harbor, sound, bay, canal or other navigable water of the United States shall be obstructed or endangered by any sunken vessel, boat, water craft, raft, or other obstruction, and such obstruction has existed for a longer period than thirty days, or whenever the abandonment of such obstruction can be legally established in a less space of time, the sunken vessel, boat, water craft, raft, or other obstruction shall be subject to be broken up, removed, sold, or otherwise disposed of by the Secretary of War at his discretion, without liability for any damage to the owners of the same: *Provided*, That in his discretion, the Secretary of War may cause reasonable notice of not less than thirty days, unless the legal abandonment of the obstruction can be established in a less time, to be given to all persons interested, either personally or by publication in a newspaper published nearest to the locality of the obstruction, requiring them to remove such obstruction: *And provided also*, That the Secretary of War may, in his discretion, at or after the time of serving such notice, cause sealed proposals to be solicited by public advertisement, giving reasonable notice of not less than ten days, for the removal of such obstruction as soon as possible after the expiration of the above specified thirty days' personal or published notice, in case it has not in the meantime been so removed, these proposals and contract at his discretion to be conditioned that such vessel, boat, water craft, raft, or other obstruction, and all cargo and property contained therein, shall become the property of the contractor, and the contract shall be awarded to the bidder making the proposition most advantageous to the United States, provided he shall give satisfactory security to execute the work: *Provided further*, That any money received from the sale of any such wreck or from any contractor for the removal of wrecks under this paragraph shall be deposited to the credit of the Treasurer of the United States.

SEC. 12. That under emergency in the case of any vessel, boat, water craft, or raft sinking or grounding, or being unnecessarily delayed in any Government canal or lock, or in any navigable channel of the United States in such manner as to stop, seriously interfere with, or specially endanger navigation in the opinion of the Secretary of War, or any agent of the United States to whom the Secretary may delegate proper authority, the latter shall have the right to take immediate possession of such boat, vessel, or other water craft, or raft, so far as to remove it and to clear immediately the canal, lock, or navigable channel of the obstruction thereby caused, using his best judgment to prevent any unnecessary injury to the removed craft; and no one shall interfere or prevent such removal: *Provided*, That the officer or agent charged with the removal of an obstruction under this section may in his discretion give notice in writing to the owners of any such obstruction, requiring them to remove it: *And provided further*, That the expense of removing any such obstruction as aforesaid shall be a charge against such craft and cargo, and if the owners thereof fail or refuse to reimburse the United States for such expense within thirty days after notification then the officer or agent aforesaid may sell the craft or cargo or any part thereof that may not have been destroyed in removal, and the proceeds of such sale shall be covered into the Treasury of the United States.

Such sum of money as may be necessary to execute this section and the preceding section of this act is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to be paid out on the requisition of the Secretary of War.

SEC. 13. That all laws or parts of laws inconsistent with this act are hereby repealed.

LAWS

AFFECTING

THE CORPS OF ENGINEERS,

UNITED STATES ARMY,

FIFTY-FOURTH CONGRESS, SECOND SESSION, AND
FIFTY-FIFTH CONGRESS, FIRST SESSION.

1896–1897.

LAWS

AFFECTING

THE CORPS OF ENGINEERS, UNITED STATES ARMY.

FIFTY-FOURTH CONGRESS, SECOND SESSION, 1896-97.

PUBLIC ACTS.

January 13, 1897.

CHAP. 12.—An Act To approve and ratify the construction of a bridge over and across Caddo Lake, at Mooringsport, Louisiana, by the Kansas City, Shreveport and Gulf Railway Company.

Bridge across Caddo Lake, Mooringsport, La., by Kansas City, Shreveport and Gulf Railway Company, approved.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the construction by the Kansas City, Shreveport and Gulf Railway Company, a corporation duly organized under the laws of the State of Louisiana, of the bridge over Caddo Lake, at the village of Mooringsport, Louisiana, be, and the same hereby is, approved and ratified, subject to the stipulations and conditions hereinafter set forth.

Lawful structure and post route.

SEC. 2. That said bridge, so long as maintained according to the limitations of this Act, shall be a lawful structure, and shall be known and recognized as a post route, and the same is hereby declared to be a post route, upon which no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or for through passengers or freight passing over the same, than the rate per mile paid for their transportation over the railroads leading to said bridge, and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge for a postal telegraph.

Postal telegraph.

Secretary of War to approve changes, etc.

SEC. 3. That said bridge shall be under and subject to such regulations for the security of the navigation of said lake as the Secretary of War shall prescribe, and the present plan and structure of said bridge shall not be altered or changed except by consent of the Secretary of War, and with his approval of the proposed change or alteration; and to secure that object the said company or corporation shall submit to the Secretary of War, for file, a design and drawings of said bridge and a map of the location, prepared with reference to a known datum plane, upon prescribed scale, furnished by the engineer officer having supervision of said lake, giving, for the space of one mile above and one mile below the location of the bridge, the topography of the banks of the lake, with shore lines at high and low water, the direction and strength of the currents at all stages, and the soundings accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject: *Provided*, That any change or alteration in the said bridge which the Secretary of War may deem necessary in the interest of navigation shall be made by the said railroad company at its own expense: *Provided, also*, That said bridge shall be so kept and managed by the company owning or operating it as to afford during the periods at which the lake is navigable proper ways and means for the passage through or under it of vessels, barges, or rafts, both by day and by night; and during the periods at which the lake is navigable there shall be displayed on said bridge from sunset to sunrise such lights and signals as may be directed by the Light-House Board.

Provisos. Expenses of changes.

Aids to navigation.

Lights, etc.

Use by other companies.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties.

Compensation.

Amendment, etc.

SEC. 5. That Congress reserves the right to alter, amend, or repeal this Act at any time.

Approved, January 13, 1897.

January 13, 1897.

CHAP. 13.—An Act Authorizing the Kansas City, Watkins and Gulf Railway Company to construct and maintain a bridge across the Black River, in Louisiana.

Kansas City, Watkins and Gulf Railway Company may bridge Black River, Louisiana.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Kansas City, Watkins and Gulf Railway Company, a corporation created and existing under and by virtue of the laws of the State of Louisiana, be, and is hereby, authorized to construct and maintain a bridge across Black River, in the State of Louisiana, at such point suitable to the interests of navigation as may hereafter be selected by said railway company for crossing said river with its railroad line. Said bridge shall be constructed to provide for the passage of railway trains, and at the option of said railway company, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and

Railway, wagon, and foot bridge.

for foot passengers, for such reasonable rates of toll as may be fixed by said railway company and approved by the Secretary of War. Toll.

SEC. 2. That said bridge built under this Act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and munitions of war of the United States than the rate per mile paid for the transportation over the railroad or public highways leading to the said bridge, and shall enjoy the rights and privileges of other post roads in the United States; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies, and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes: *Provided*, That the bridge herein authorized to be constructed shall be so kept and managed by the company owning or operating it as to afford proper ways and means for the passage through or under it of vessels, barges, or rafts at all times, both by day and by night; and there shall be displayed on said bridge, from sunset to sunrise, such lights and signals as the Light-House Board shall prescribe.

Lawful structure and post route.

Postal telegraph.

Proviso.
Aids to navigation.

Lights, etc.

SEC. 3. That if said bridge, erected and maintained under the authority of this Act, shall at any time substantially or materially obstruct the free navigation of said river or shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction, and such alteration shall be made and all such obstructions be removed at the expense of the owner or owners of said bridge; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, the case may be brought in the district court of the United States in the State of Louisiana in which any portion of said obstruction or bridge may be located: *Provided*, That nothing in this Act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers or to exempt said bridge from the operation of the same.

Changes, etc.

Litigation.

Proviso.
Existing laws not affected.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; or, in case of disagreement, upon such terms and conditions as may be prescribed by the Secretary of War upon hearing the allegations and proofs of the parties in interest.

Use by other companies.

Compensation.

SEC. 5. That the bridge authorized to be constructed under this Act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe, and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and

Secretary of War to approve plans, etc.

approval, a design and drawings of said bridge and a map of the location, prepared with reference to a known datum plane, upon prescribed scale, furnished by the Engineer officer having supervision of said river, and giving for the space of two miles above and two miles below the proposed location of the bridge the topography of the banks of the river, with shore lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plans and location of the bridge are approved by the Secretary of War the bridge shall not be built, and should any change be made in the plan of the said bridge during the process of construction, such change shall be subject to the approval of the Secretary of War, and said structure shall be changed at the cost and expense of the owners thereof from time to time as the Secretary of War may direct, so as to preserve the free and convenient navigation of said river.

Changes.

Commencement and completion.

SEC. 6. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Amendment.

SEC. 7. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Approved, January 13, 1897.

January 20, 1897.

CHAP. 69.—An Act To approve and ratify the construction of a bridge across the Red River, between the States of Arkansas and Texas, at a point above the town of Fulton, in Arkansas, on said river, built by the Texarkana Northern Railway Company, but now owned and operated by the Texarkana and Fort Smith Railway Company, and to authorize the latter company to maintain said bridge over said waterway, subject to certain stipulations and conditions.

Bridge across Red River, Fulton, Ark., by Texarkana and Fort Smith Railway Company approved.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the construction by the Texarkana Northern Railway Company, a corporation formed for the purpose of constructing and operating a railroad northward from the town of Texarkana, in the States of Texas and Arkansas, but which has been merged into and succeeded by the corporation known as the Texarkana and Fort Smith Railway Company, of the bridge over the Red River, between the States of Arkansas and Texas, above the town of Fulton, in Arkansas, on the said river, be, and the same hereby is, approved and ratified, subject to the stipulations and conditions hereinafter set forth.

Lawful structure and post route.

SEC. 2. That said bridge, so long as maintained according to the limitations of this Act, shall be a lawful structure, and shall be known and recognized as a post route, and the same is hereby declared to be a post route, upon which no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or for through passengers or freight passing over the same, than the rate per mile paid for their transportation over the railroads leading to said bridge; and the United States shall have the right of way across said bridge for a postal telegraph.

Postal telegraph.

SEC. 3. That said bridge shall always be provided with a suitable draw, which shall be maintained by said railroad company, and at its expense, so as not to interfere with the navigation of said river, and in such way as to render navigation through the same free, easy, and unobstructed.

Unobstructed navigation.

SEC. 4. That the draw provided for the said bridge shall be opened promptly, upon reasonable signal, for the passing of boats and rafts; and said railroad company shall maintain, at its own expense, from sunset until sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

Opening draw.

Lights.

SEC. 5. That said bridge shall be under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe, and the present plan and structure of said bridge shall not be altered or changed except by consent of the Secretary of War, and with his approval of the proposed change or alteration: *Provided*, That any change or alteration in the said bridge which the Secretary of War may deem necessary in the interest of navigation shall be made by the said railroad company at its own expense. And if, after thirty days' notice from the Secretary of War to the president of the railroad company, or to other parties owning or controlling said bridge, the changes or alterations required shall not be made, the Secretary may cause such changes to be made, and the cost thereof shall be recovered by suit in the name of the United States against said company in the circuit court of the United States within whose jurisdiction said bridge or any part thereof is situated.

Secretary of War to approve changes, etc.

Proviso.
Changes.

SEC. 6. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties.

Use by other companies.

Compensation.

SEC. 7. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of approval thereof.

Commencement and completion.

SEC. 8. That Congress reserves the right to alter, amend, or repeal this Act at any time.

Amendment, etc.

Approved, January 20, 1897.

January 26, 1897.

CHAP. 90.—An Act To authorize the construction of a bridge over the Monongahela River from the borough of Braddock to the township of Mifflin, Pennsylvania.

Braddock and Duquesne Bridge Company may bridge Monongahela River, Allegheny County, Pa.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Braddock and Duquesne Bridge Company, a corporation duly organized under the laws of the Commonwealth of Pennsylvania, its successors, lessees, and assigns be, and are hereby, authorized and empowered to construct, maintain, and operate a bridge over the Monongahela River from a point in Allegheny County, Pennsylvania, in the borough of Braddock, on Thirteenth street, to a point on the opposite side of said river on the property of T. Kinney, in Mifflin Township, in said county.

Railway, wagon, and foot bridge.

Toll.

SEC. 2. That said bridge may be constructed to provide for the passage of railway trains, street cars, wagons, and vehicles of all kinds, for the transit of animals, foot passengers, and of commercial travel and communication. The said corporation may charge and receive such reasonable tolls therefor as may be approved from time to time by the Secretary of War.

Lawful structure and post route.

Provisos.

Postal telegraph.

Commencement.

SEC. 3. That any bridge built under this Act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, and it shall enjoy the rights and privileges of other post roads in the United States: *Provided,* That the United States may construct a postal telegraph over said bridge without charge therefor: *And provided also,* That the said Braddock and Duquesne Bridge Company shall not commence the construction of its bridge, bridge piers, abutments, causeways, and other works over or in said Monongahela River until the location and plan of same shall have been submitted to and approved by the Secretary of War.

Secretary of War to approve plans, etc.

Changes.

SEC. 4. That any bridge authorized to be constructed under this Act shall be located and built under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the said Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location, giving, for the space of one-half mile above and one-half mile below the proposed location, the high and low water lines upon the banks of the river, the direction and strength of the currents at high and low water, with the soundings, accurately showing the bed of the stream and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for the full and satisfactory understanding of the subject. And until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built. And should any change be made in the plan of said bridge during the progress of its construction such change shall be submitted to the approval of the

Secretary of War: *Provided*, That the channel span of said bridge shall not be less than five hundred feet in length in the clear and the clear height of the superstructure shall not be less than fifty-four feet above the level of the water at pool full in said river.

Proviso. Channel span.

SEC. 5. That said bridge herein authorized to be constructed shall be so kept and managed at all times as to afford proper means and ways for the passage of vessels, barges, or rafts, both by day and by night. And there shall be displayed on said bridge by the owners thereof, from sunset to sunrise, such lights and other signals as the Light-House Board may prescribe. And such changes shall be made from time to time in the construction of said bridge as the Secretary of War may direct, at the expense of said bridge company, in order the more effectually to preserve the free navigation of said river.

Aids to navigation.

Lights, etc.

SEC. 6. That all railroad or street car companies desiring the use of the bridge authorized by this Act shall have and be entitled to equal rights and privileges relative to the passage of trains or cars over the same, and over the approaches thereto upon the payment of a reasonable compensation for such use; and in case the owner or owners of such bridge and the several companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies.

Use by other companies.

Compensation.

Telegraph and telephone companies.

SEC. 7. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of the approval of this Act.

Commencement and completion.

SEC. 8. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Amendment, etc.

Approved, January 26, 1897.

CHAP. 91.—An Act To authorize the Union Railroad Company to construct and maintain a bridge across the Monongahela River.

January 26, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Union Railroad Company, a corporation existing under the laws of the State of Pennsylvania, is hereby authorized to construct, maintain, and operate a railroad bridge, with single or double track, for railroad traffic across the Monongahela River within the limits of Allegheny County, State of Pennsylvania, the southerly end of said bridge to be located at some point in Mifflin Township, in said county. The said bridge, when built in accordance with the requirements of this Act, shall be a legal structure, and may be used for railroad and highway purposes.

Union Railroad Company may bridge Monongahela River, Allegheny County, Pa.

Vol. 27, p. 462.

Legal structure, etc.

Secretary of War to approve plans, etc.

SEC. 2. That the bridge authorized to be constructed under this Act shall be located and built under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe, and to secure that object the railroad company shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location, giving for the space of one mile above and below the proposed location the depth and currents at all points of the same and the location of any other bridge or bridges, together with all other information touching said bridge and river as may be deemed requisite by the Secretary of War to determine whether said bridge when built will conform to the provisions of this Act and cause any serious obstruction to the navigation of the river or injuriously affect the flow of water.

Notification of approval.

SEC. 3. That the Secretary of War is hereby authorized and directed, upon receiving said plan and map, and upon being satisfied that a bridge built on such a plan and at said locality will conform to the provisions of this Act and cause no serious obstruction to the navigation of the river or injuriously affect the flow of water, to notify the said company that he approves the same, and upon receiving such notification the said company may proceed to the erection of said bridge, conforming strictly to the approved plan and location. But until the Secretary of War shall approve the plan and location of the said bridge, and notify the said company of the same in writing, the bridge shall not be built or commenced; and should any change be made in the plan of the bridge during the progress of the work thereon, such change shall be subject likewise to the approval of the Secretary of War.

Changes, etc.

Railroad, etc., bridge.

SEC. 4. That said bridge shall be constructed to provide for the passage of railroad trains, and, at the option of the corporation by which it may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers, for such reasonable rates of toll as may be approved from time to time by the Secretary of War: *Provided*, That all railroad companies desiring the use of the bridge authorized by this Act shall have and be entitled to equal rights and privileges relative to the passage of trains or cars over the same and over the approaches thereto upon the payment of a reasonable compensation for such use; and in case the owner or owners of such bridge and the several companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies.

Toll.

Proviso.
Use by other companies.

Compensation.

Lawful structure and post route.

SEC. 5. That any bridge constructed under this Act shall be a lawful structure and shall be known as a post road, over which no higher charge shall be made for the transportation of mails, troops, and munitions of war, or other property of the Government of the United States, or for passengers or freight passing over the same, than the rate per mile charged for their transportation over the railways or public highways leading to said bridge. The United States shall also have the right of way over said bridge for postal-telegraph purposes.

Postal telegraph.

SEC. 6. That said bridge herein authorized to be constructed shall be so kept and managed at all times as to afford proper means and ways for the passage of vessels, barges, or rafts, both by day and by night; and there shall be displayed on said bridge by the owners thereof, from sunset to sunrise, such lights or other signals as the Light-House Board may prescribe; and such changes shall be made from time to time in the structure of said bridge as the Secretary of War may direct, at the expense of the said company, in order the more effectually to preserve the free navigation of said river.

Aids to navigation.

Lights, etc.

SEC. 7. That this Act shall be null and void unless the construction of said bridge shall be commenced within one year and completed within three years from the passage of this Act.

Commencement and completion.

SEC. 8. That Congress shall have power at any time to alter, amend, or repeal this Act.

Amendment, etc.

Approved, January 26, 1897.

CHAP. 93.—An Act Authorizing the Kansas City, Watkins and Gulf Railway Company to construct and maintain a bridge across Red River at the city of Alexandria, Louisiana.

January 26, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Kansas City, Watkins and Gulf Railway Company, a corporation created and existing under and by virtue of the laws of the State of Louisiana, be, and is hereby, authorized to construct and maintain a bridge across Red River at a point suitable to the interests of navigation, at the city of Alexandria, in the State of Louisiana. Said bridge shall be constructed to provide for the passage of railway trains and, at the option of the said railway company, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers, for such reasonable rates of toll as may be fixed by said railway company and approved by the Secretary of War.

Kansas City, Watkins and Gulf Railway Company may bridge Red River, Alexandria, La.

Railway, etc., bridge.

Toll.

SEC. 2. That said bridge built under this Act and subject to its limitations shall be a lawful structure and shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and munitions of war of the United States than the rate per mile paid for the transportation over the railroad or public highways leading to the said bridge, and shall enjoy the rights and privileges of other post roads in the United States; and equal privi-

Lawful structure and post route.

Postal telegraph.

leges in the use of said bridge shall be granted to all telegraph and telephone companies, and the United States shall have the right of way across said bridge and its approaches for postal telegraph purposes: *Provided*, That the bridge herein authorized to be constructed shall be so kept and managed by the company owning or operating it as to afford proper ways and means for the passage through or under it of vessels, barges, or rafts at all times, both by day and by night; and there shall be displayed on said bridge, from sunset to sunrise, such lights and signals as the Light-House Board shall prescribe.

Proviso.

Aids to navigation.

Lights, etc.

SEC. 3. That if said bridge, erected and maintained under the authority of this Act, shall at any time, substantially or materially, obstruct the free navigation of said river, or shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction; and such alteration shall be made and all such obstructions be removed at the expense of the owner or owners of said bridge. And in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river the case may be brought in the district court of the United States for the western district of Louisiana: *Provided*, That nothing in this Act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers or to exempt said bridge from the operation of the same.

Unobstructed navigation.

Litigation.

Proviso.

Existing laws not affected.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same and the approaches thereto upon payment of a reasonable compensation for such use; or, in case of disagreement, upon such terms and conditions as shall be prescribed by the Secretary of War upon hearing the allegations and proofs of the parties in interest.

Use by other companies.

Compensation.

SEC. 5. That the bridge authorized to be constructed under this Act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe, and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of said bridge and a map of the location, prepared with reference to a known datum plane, upon prescribed scale, furnished by the Engineer officer having supervision of said river, and giving for the space of two miles above and two miles below the proposed location of the bridge the topography of the banks of the river, with shore lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plans and location of the bridge are approved by the Secretary of

Secretary of War to approve plans, etc.

War the bridge shall not be built; and should any change be made in the plan of the said bridge during the process of construction such change shall be subject to the approval of the Secretary of War, and said structure shall be changed at the cost and expense of the owners thereof from time to time, as the Secretary of War may direct, so as to preserve the free and convenient navigation of said river. Changes.

SEC. 6. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof. Commencement and completion.

SEC. 7. That the right to alter, amend, or repeal this Act is hereby expressly reserved. Amendment, etc.

Approved, January 26, 1897.

CHAP. 99.—An Act Authorizing the construction of a bridge across the Columbia River, in the State of Washington. January 27, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the assent of Congress is hereby given to the Columbia and Red Mountain Railway Company, a corporation existing under the laws of the State of Washington, to construct, maintain, and operate a railway within that State, and to its successors and assigns, to construct and maintain a bridge and approaches thereto across the Columbia River, in the State of Washington, at such point on said river in the county of Stevens as may accommodate the line of railway which said corporation may build to said point. Said bridge shall be constructed to provide for the passage of railway trains, and at the option of the said corporation may be used for the passage of wagons and vehicles of all kinds, and for the transit of animals and for foot passengers, for such reasonable rates of toll as may be fixed by the Secretary of War; and the Secretary of War shall have the right from time to time to revise such rates. Columbia and Red Mountain Railway Company may bridge Columbia River, Stevens County, Wash. Railway, etc., bridge. Toll.

SEC. 2. That the said bridge shall be so constructed that a free and unobstructed passage may be secured to all water craft, rafts, or logs navigating said river at the point aforesaid. The said bridge shall be located, built, and operated under and subject to such regulations for the securing of the navigation of said river, and such requirements as to location and direction of piers and spans, clear heading in high water, and clear spans at low water, as the Secretary shall prescribe; and to secure that object the said company shall submit to the Secretary of War, for his examination and approval, drawings of said bridge and piers, and a map of the location, giving, for the space of one mile below and one mile above the proposed location, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current at ordinary high and low stages, and the soundings, accurately showing the bed and channel of the stream, and shall furnish such infor- Unobstructed navigation. Secretary of War to approve plans, etc.

mation as shall be required for a full and satisfactory understanding of the subject; and, until the said location and plan of the bridge hereby authorized to be constructed are approved by the Secretary of War, the said bridge shall not be commenced or built; and should any change be made in the plan of such bridge during the progress of construction or after completion thereof, such change shall be subject to the approval of the Secretary of War: *Provided*, That the persons or corporation owning said bridge shall maintain, at their own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

Proviso.

Lights, etc.

SEC. 3. That the bridge authorized to be constructed under this Act shall be a lawful structure and shall be recognized and known as a post route, upon which, also, no higher charge shall be made for the transmission over the same of the mails, troops, and munitions of war of the United States, or for through railway passengers or freight passing over said bridge, than the rate per mile paid for their transmission over the railroads leading to said bridge; and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes, and all telegraph or telephone companies shall have equal rights.

Lawful structure and post route.

Postal telegraph, etc.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation to the owners of said bridge, and should the several railroad companies, or any one of them, desiring such use, fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties; and all telephone and telegraph companies shall have equal rights and privileges in constructing and operating their lines across said bridge.

Use by other companies.

Compensation.

Telephone and telegraph companies.

SEC. 5. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Commencement and completion.

SEC. 6. That such alterations or changes as may be required by the Secretary of War or Congress in the bridge constructed under the provisions of this Act shall be made by the said railroad company at its own expense, and at any time after the completion of the bridge; and the right to alter, amend, or repeal this Act is hereby expressly reserved; and the right to require the entire removal of the bridge constructed under the provisions of this Act, at the expense of the owners thereof, whenever Congress shall decide that the public interests require it, is also expressly reserved.

Changes.

Amendment, etc.

Approved, January 27, 1897.

CHAP. 108.—An Act To authorize the Muskogee, Oklahoma and Western Railroad Company to construct and operate a line of railway through Oklahoma and the Indian Territory, and for other purposes. January 29, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Muskogee, Oklahoma and Western Railroad Company, a corporation created and existing under the laws of the Territory of Oklahoma, be, and the same is hereby, invested and empowered with the right of locating, constructing, owning, equipping, operating, using, and maintaining a railway, telegraph, and telephone line through the Indian allotments in severalty in the Territory of Oklahoma along such line or route as may be granted it by the laws thereof, and through the Indian Territory, beginning at a point on the northern line of the Creek Nation, Indian Territory, at or near the mouth of the Cimarron River, running thence by the most feasible and practicable route to the town of Muskogee, Creek Nation; thence in a northeasterly direction by the way of Fort Gibson and Tahlequah to such a point on the western boundary line of the State of Arkansas between the Arkansas River and the northern line of the State of Arkansas as said corporation may elect, with the right to construct, use, and maintain such tracks, bridges, and sidings as said company may deem it to their interests to construct along and upon the right of way and depot grounds herein provided for, with the right to construct two branch lines of road, one commencing at the town of Muskogee, in the Creek Nation, and running thence in a southeasterly direction on the south side of the Arkansas River to the west boundary line of the State of Arkansas, the other commencing at or near said town of Muskogee and running thence in a southwesterly direction by the most feasible and practicable route to such a point on the eastern boundary of Oklahoma Territory, south of the Canadian River, as said company may select; and the company shall have the same rights and privileges for its branch railway, telegraph, and telephone lines as for its main line.

Muskogee, Oklahoma and Western Railroad Company granted right of way, Oklahoma and Indian Territories.

Location.

Branches.

* * * * *

SEC. 8. That said company shall build at least one hundred miles of its railway in the Indian Territory within three years after the passage of this Act, and complete the main line and branches thereof within three years thereafter, or the rights herein granted shall be forfeited as to that portion not built, and that without any declaration of forfeiture on the part of any officer or employee of the Government. And said company shall also construct and continuously maintain all roads, highway crossings, and necessary bridges over said railway wherever said roads and highways do now or may hereafter cross said company's right of way or may be by the proper authorities laid out across the same. And said railroad company is also hereby authorized in case it so elects, for the greater accommodation of the public, to so construct its bridge across the Arkansas River as to make it a suitable and safe structure

Commencement and completion.

Crossings, etc.

May bridge Arkansas River.

for the crossing of vehicles of all kinds, animal and foot travelers, as well as railroad trains: *Provided*, That the plans of construction of all bridges across navigable streams, along and upon the right of way herein provided for, shall be subject to the approval of the Secretary of War. But if said bridge across the Arkansas River is constructed for said additional use, then the said railroad company shall have the right to construct and maintain the necessary wagon-road approaches to the nearest public highway at each end of the bridge: *Provided further*, That said railroad company, in case of the construction of said bridge for the additional uses herein named, shall be authorized to collect tolls from all who may use said bridge, but the toll fees charged shall not be greater than the toll fees allowed by the laws of the State of Arkansas for like services on toll bridges across the Arkansas River in that State: *Provided further*, That this Act shall not be so construed as to give or grant said company any right, title, or interest in or to the wagon-road approaches to the nearest public highways which it is authorized to construct from the ends of the bridge, or to charge or collect toll fees for traveling over said wagon-road approaches.

Provisos.

Secretary of War to approve plans, etc.

Toll.

Approaches to bridge.

* * * * *

Assignment forbidden.

SEC. 11. That the right of way herein and hereby granted shall not be assigned or transferred in any form whatever prior to the construction and completion of the road, except as to mortgage or other liens that may be given or secured thereon to aid in the construction thereof.

Amendment, etc.

SEC. 12. That Congress may at any time amend, add to, alter, or repeal this Act.

Received by the President, January 18, 1897.

[NOTE BY THE DEPARTMENT OF STATE.—The foregoing act having been presented to the President of the United States for his approval, and not having been returned by him to the house of Congress in which it originated within the time prescribed by the Constitution of the United States, has become a law without his approval.]

January 30, 1897.

CHAP. 112.—An Act To establish railroad bridges across the Cumberland and Tennessee rivers, in Kentucky.

Cairo and Tennessee River Railroad Company may bridge Cumberland and Tennessee rivers, Kentucky.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Cairo and Tennessee River Railroad Company, a corporation organized under the laws of the State of Tennessee, its successors and assigns, is hereby authorized and empowered to erect, construct, establish, and maintain railway bridges and approaches thereto across the Cumberland River, in the State of Kentucky, at points to be selected by said railroad, or its successors or assigns, between Rockcastle and Tobaccoport, in Trigg County, and also another bridge across said river between Burksville, on said river, in Kentucky, and the Tennessee State line, and also a bridge across the Tennessee River, between Pine Bluff, in Calloway County, Kentucky, and Birmingham, in Marshall County, Kentucky, the locations of said bridges to be selected by said railroad, or its successors or assigns, between said described points on said rivers, which said bridges shall not interfere with the free navigation of said rivers; and in case of any litigation arising from any obstruction or alleged obstruction to free navigation of said rivers the proceedings shall be instituted in and determined by the district court of the United States for the district of the State of Kentucky.

Litigation.

SEC. 2. That the bridges authorized by and constructed under this Act shall be pivot drawbridges, and the bridges shall have a draw over the main channel of the rivers at accessible and navigable points, with spans of not less than one hundred and seventy-five feet in length on each side of the center of the pivot piers of the draws, and the remaining spans of such length as shall be necessary to reach the approaches on either side of the river, all spans to have a clear head-room of ten feet above high water; and the piers of said bridges shall be parallel with the current of the rivers when said bridges shall be erected: *Provided*, That the length of the drawspans may be increased if, in the opinion of the Secretary of War, the interests of navigation demand it.

Pivot drawbridges.

Proviso. Drawspans.

SEC. 3. That any bridge constructed under this Act and according to its limitations shall be a lawful structure, and shall be known and recognized as a post route, and the same is hereby declared to be a post route, and it shall enjoy the same rights and privileges as other post roads in the United States, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for their transportation over the railroads leading to said bridge; and the United States shall have the right of way for a postal telegraph across said bridge.

Lawful structures and post routes.

Postal telegraph.

SEC. 4. That all railroad companies desiring the use of said bridges shall have and be entitled to equal rights and privileges relative to the passage of railroad trains over the same and the approaches thereto, and in the use of the machinery and fixtures thereof, upon payment of a reasonable compensation for such use, and in case the owner or owners of said bridges and the railroad companies, or any of them, desiring such use shall fail to agree upon the sum or sums to be paid as such compensation, and upon rules and conditions to which each shall conform in using said bridges, or either of said matters, then all matters in dispute or at issue between them, or any of them, shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Use by other companies.

Compensation.

SEC. 5. That the structures herein authorized shall be built and located under and subject to such regulations for the security of navigation of said rivers as the Secretary of

Secretary of War to approve plans, etc.

War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, designs and drawings of said bridges and maps of the locations, giving, for the space of one mile above and one mile below the proposed locations, the topography of the banks of the rivers, the shore lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the streams, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plans and locations of the bridges are approved by the Secretary of War the bridges shall not be commenced or built, and should any change be made in the plan of said bridges during the process of construction or after completion, such change shall be subject to the approval of the Secretary of War; and the said constructions shall be at all times so managed and kept as to offer reasonable and proper means for the passage of vessels through or under said structures; and to secure the safe passage of vessels at night there shall be displayed on said bridges, from the hour of sunset to that of sunrise, such lights as may be prescribed by the Light-House Board, and the said structures shall be changed, at the cost and expense of the owners thereof, from time to time, as the Secretary of War may direct, so as to preserve the free and convenient navigation of said rivers.

Aids to navigation.

Lights, etc.

Changes.

Commencement and completion.

SEC. 6. That this Act shall be null and void if actual construction of the bridges herein authorized be not commenced within three years from the date hereof, and completed within five years.

Amendment, etc.

SEC. 7. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Approved, January 30, 1897.

January 30, 1897.

CHAP. 113.—An Act Extending the time for the completion of the bridge across the East River, between the city of New York and Long Island, now in course of construction, as authorized by the Act of Congress approved March third, eighteen hundred and eighty-seven.

East River, New York.
Time extended for completing bridge over.
Vol. 24, p. 469.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the time for the completion of the bridge of the New York and Long Island Bridge Company across the East River, between the city of New York and Long Island, authorized by the Act of Congress entitled "An Act authorizing the construction of a bridge across the East River, between the city of New York and Long Island," approved March third, eighteen hundred and eighty-seven, and the various Acts amendatory thereof or supplementary thereto, is hereby extended to and including the first day of January in the year nineteen hundred.

Approved, January 30, 1897.

CHAP. 121.—An Act To provide for an examination and survey of a water route from the mouth of the jetties at the city of Galveston, Texas, through the ship channel and up Buffalo Bayou to the city of Houston, Texas.

February 1, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he hereby is, authorized and directed to make an examination and survey, with an estimate of the necessary cost, for a water channel not less than twenty-five feet deep and one hundred feet wide, extending from the mouth of the jetties at the city of Galveston, Texas, through the existing ship channel and up Buffalo Bayou to the city of Houston, Texas, and for a harbor at or near Houston of a depth of not less than twenty-five feet and of a width of five hundred feet, and to make a report of such examination, survey, and estimate, with its commercial importance, to Congress.

Water route, Galveston to Houston, Tex.

Survey, etc., directed.

SEC. 2. That the cost of said examination, survey, and estimate be paid out of funds already appropriated for work on the improvement of the ship channel and Buffalo Bayou.

Expense.

Vol. 29, pp. 209, 222.

Approved, February 1, 1897.

CHAP. 122.—An Act To authorize the construction or acquisition of a bridge across the Rio Grande River at El Paso, in the State of Texas.

February 1, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Sierra Madre Construction Company, a corporation duly incorporated under the laws of the State of New Jersey, and its successors and assigns, be, and the same is hereby, authorized to erect, construct, maintain, and operate a bridge over the Rio Grande River at the city of El Paso, in the State of Texas, at such point on said river in the county of El Paso as may accommodate the line of railway which said corporation may build to said point. Said bridge shall be constructed so as to provide for the passage of railway trains and shall be used for the passage of wagons and vehicles of all kinds, and for the transit of animals and for foot passengers, and for the transit of freight, goods, wares, and merchandise, for such reasonable rates of toll as may be fixed by the Secretary of War; and the Secretary of War shall have the right from time to time to revise such rates.

Sierra Madre Construction Company may bridge Rio Grande, El Paso, Tex.

Railway, etc., bridge.

Toll.

SEC. 2. That said bridge may be built with unbroken and continuous spans and of the following dimensions, to wit: Six hundred feet in length, twenty feet in width, ten feet in height above high-water level, and with twenty-eight spans, twelve of which to be thirty feet in length and sixteen of which to be fifteen feet in length, completed in the manner herein specified, shall be deemed and taken to be a legal structure.

Construction.

Unobstructed navigation.

SEC. 3. That said bridge shall not interfere with the free navigation of said river, and in case of any litigation arising from an obstruction or an alleged obstruction to the free navigation thereof, caused or alleged to be caused by said bridge, the case may be tried before the circuit or district court of the United States for the State in which any portion of said bridge may be situated.

Use by railroad companies.

Compensation.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation to the owners of said bridge, and should the several railroad companies, or any one of them, desiring such use, fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties; and all telephone and telegraph companies shall have equal rights and privileges in constructing and operating their lines across said bridge.

Consent of Mexican authorities.

SEC. 5. That the consent of the State of Chihuahua, United States of Mexico, and of the proper authorities of the Republic of Mexico shall have been obtained before said bridge shall be built or commenced.

Commencement and completion.

SEC. 6. That unless the construction of said bridge be commenced within one year and finished within three years from the date of the passage of this Act the provisions of this Act shall be null and void.

Reservation of authority.

Amendment, etc.

SEC. 7. That Congress reserves the right to withdraw the authority and power conferred by this Act in case the free navigation of said river shall at any time be substantially or materially obstructed by said bridge, or for any other reason, and to direct the removal or necessary modifications thereof at the cost and expense of the owners of said bridge; and Congress may at any time alter, repeal, or amend this Act.

Purchase of existing bridge.
Vol. 22, p. 179;
Vol. 25, p. 457.

SEC. 8. That said company, instead of erecting such bridge, may acquire by purchase or otherwise the property and franchises of any street-railway bridge heretofore authorized by Congress to be built and now built and in operation across said river at said point.

Reconstruction, etc.

SEC. 9. That said company may in such case remodel and strengthen such bridge so acquired so as to conform in all particulars to the requirements for a new bridge, as hereinbefore set out, and may maintain and operate such bridge under the conditions of its original franchises, subject to all the provisions of this Act in respect to a new bridge.

Consent of Mexican authorities.

SEC. 10. That the consent of the State of Chihuahua, United States of Mexico, and of the proper authorities of the Republic of Mexico shall have been obtained before such property and franchises are acquired.

Approved, February 1, 1897.

CHAP. 146.—An Act To authorize officers who served during the war of the rebellion in the Regular Army to bear the title and, on occasions of ceremony, wear the uniform of their highest rank.

February 4, 1897.

Army.

Title and uniform of highest rank allowed ex-officers for service during the rebellion.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all officers who have served during the rebellion as officers of the Regular Army of the United States, and have been honorably discharged or resigned from the service, shall be entitled to bear the official title and, upon occasions of ceremony, to wear the uniform of the highest grade they have held, by brevet or other commission, as is now authorized for officers of volunteers by section twelve hundred and twenty-six, Revised Statutes.

R. S., sec. 1226, p. 212.

Approved, February 4, 1897.

CHAP. 173.—An Act To approve and ratify the construction of a bridge across the Sulphur River, in the State of Arkansas, by the Texarkana and Fort Smith Railway Company.

February 8, 1897.

Texarkana and Fort Smith Railway Company may bridge Sulphur River, Arkansas.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the construction by the Texarkana and Fort Smith Railway Company, a corporation duly organized under the laws of the State of Arkansas, of the bridge over the Sulphur River, in said State of Arkansas, be, and the same hereby is, approved and ratified, subject to the stipulations and conditions hereinafter set forth.

Lawful structure and post route.

SEC. 2. That said bridge, so long as maintained according to the limitations of this Act, shall be a lawful structure, and shall be known and recognized as a post route, and the same is hereby declared to be a post route, upon which no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or for through passengers or freight passing over the same, than the rate per mile paid for their transportation over the railroads leading to said bridge; and the United States shall have the right of way across said bridge for a postal telegraph.

Postal telegraph.

Secretary of War to prescribe regulations, etc.

SEC. 3. That said bridge shall be under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe, and the present plan and structure of said bridge shall not be altered or changed except by consent of the Secretary of War, and with his approval of the proposed change or alteration: *Provided*, That any change or alteration in the said bridge which the Secretary of War may deem necessary in the interest of navigation shall be made by the said railroad company at its own expense.

Proviso. Changes.

Use by other companies.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties. Compensation.

Amendment, etc. SEC. 5. That Congress reserves the right to alter, amend, or repeal this Act at any time.

Approved, February 8, 1897.

February 8, 1897.

CHAP. 174.—An Act To authorize the construction by the Kansas City, Shreveport and Gulf Railroad Company of a bridge across the Sabine River between the States of Louisiana and Texas.

Kansas City, Shreveport and Gulf Railroad Company may bridge Sabine River, Orange, Tex.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Kansas City, Shreveport and Gulf Railroad Company, a corporation duly created and existing under the laws of the State of Louisiana, its successors or assigns, be, and it is hereby, authorized to construct and maintain a bridge and approaches thereto across the Sabine River at or about twenty miles above the town of Orange, in the State of Texas. Said bridge shall be constructed to provide for the passage of railway trains, and, at the option of said corporation, may be so constructed as to provide for the passage of wagons and vehicles of all kinds, animals, and foot passengers for such reasonable rates of toll as may be approved by the Secretary of War. Railway, etc., bridge. Toll.

Secretary of War to approve plans, etc. SEC. 2. That the bridge herein authorized shall be built and located under and in accordance with such regulations for the security of navigation as the Secretary of War shall prescribe; and to secure that object the said company shall submit to the Secretary of War, for his examination and approval, drawings showing the plan and location of said bridge, said drawings to give, for the space of one-half mile above and one-half mile below the proposed location, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed of the stream, and such other information as may be required for a full and satisfactory understanding of the subject; and until the plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built; and any change in the plans of said bridge, either before or after construction, shall be subject to the approval of the Secretary of War; and any change in said bridge during or after construction which the Secretary of War may require in the interest of navigation shall be made by the said company at its own expense. Changes.

Unobstructed navigation. SEC. 3. That the said bridge shall at all times be so kept and managed as to offer reasonable and proper means for the passage of vessels and other crafts through or under said structure; and if said bridge be built as a drawbridge the draw shall be opened promptly upon reasonable signal for the passage of boats or other crafts; and whatever kind of bridge is constructed, the said company shall maintain at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. Draw. Lights, etc.

SEC. 4. That any bridge built under this Act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or passengers or freight over said bridge than the rate per mile paid for the transportation over the railroads or public highways leading to said bridge; and it shall enjoy the same rights and privileges as other post roads of the United States; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies, and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes. Lawful structure and post route. Postal telegraph.

SEC. 5. That all railroad companies desiring the use of said bridge and its approaches shall have and be entitled to equal rights and privileges relative to the passage of trains over the same upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any of them, desiring such use shall fail to agree upon the sum or sums to be paid, or upon rules and conditions to which each shall conform in using said bridge and approaches, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties. Use by other companies. Compensation.

SEC. 6. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof. Commencement and completion.

SEC. 7. That the right to alter, amend, or repeal this Act is hereby expressly reserved. Amendment, etc.

Approved, February 8, 1897.

CHAP. 175.—An Act To amend the Act entitled "An Act to authorize the construction of a bridge across the Missouri River at or near the city of Lexington, Missouri," approved July twenty-sixth, eighteen hundred and ninety-four. February 8, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An act to authorize the construction of a bridge across the Missouri River at or near the city of Lexington, Missouri," approved July twenty-sixth, eighteen hundred and ninety-four, be, and the same is hereby, amended so as to extend the time for the commencement of the construction of said bridge to one year and its completion to three years from the approval of this Act. Bridge across Missouri River, Lexington, Mo. Time extended for construction. Vol. 28, p. 121.

Approved, February 8, 1897.

February 8, 1897.

CHAP. 176.—An Act To authorize the mayor and city council of Monroe, and the police jury of the parish of Ouachita, Louisiana, to construct a traffic bridge across the Ouachita River opposite said city.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the mayor and city council of the city of Monroe, and the police jury of the parish of Ouachita, in the State of Louisiana, are hereby authorized and empowered to construct, operate, and maintain a general traffic bridge across the Ouachita River, to be located at such point, within or near the corporate limits of said city as shall be approved by the Secretary of War: *Provided*, That said bridge shall be constructed as a drawbridge, and the draw shall be opened promptly, upon reasonable signal, for the passage of boats; and whatever kind of bridge is constructed the owners thereof shall maintain thereon, at their own expense, from sunset to sunrise, such lights or other signals as the Light-House Board shall prescribe: *Provided further*, That if the said bridge shall be constructed to provide for the passage of street-railway cars, all street-railroad companies desiring the use of the bridge shall have equal privileges in the passage of trains or cars over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case of disagreement in regard to the terms of such use, or the rates to be paid, the matters at issue shall be decided by the Secretary of War.

Monroe and Ouachita Parish, La., may bridge Ouachita River.

Provisos.

Drawbridge.

Lights, etc.

Use by street railroads, etc.

Compensation.

SEC. 2. That any bridge built under the provisions of this Act shall be a lawful structure, and shall be recognized and known as a post route, upon which no higher charge shall be made for the transmission over the same of the mails, troops, and munitions of war of the United States passing over said bridge than the rate per mile paid for the transportation over the public highways leading to said bridge; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge and approaches for postal-telegraph purposes; and said bridge shall be so constructed and operated as not to interfere with the navigation of said river.

Lawful structure and post route.

Postal telegraph.

Free navigation.

SEC. 3. That said municipal corporation shall have the right to charge and collect a reasonable rate of toll, to be approved by the Secretary of War, not exceeding the rate limited by the law of Louisiana.

Toll.

SEC. 4. That the bridge authorized to be constructed under this Act shall be located and built under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and to secure that object the said corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the proposed bridge, and a map of the location, giving for the space of one-half mile above and one-half mile below the proposed location the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the currents, and the soundings, accurately showing the bed of the stream, and shall furnish such other information as may be required for

Secretary of War to approve plans, etc.

a full and satisfactory understanding of the subject. And until the said plan and location of the bridge are approved by the Secretary of War, no work upon the bridge shall be commenced; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War.

Changes.

SEC. 5. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of approval hereof.

Commencement and completion.

SEC. 6. That Congress hereby expressly reserves the right to alter, amend, or repeal this Act.

Amendment, etc.

Approved, February 8, 1897.

CHAP. 234.—An Act To provide for appointment by brevet of active or retired officers of the United States Army.

February 16, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all officers of the Regular Army of the United States, active or retired, who served in the volunteer forces during the late war, may, at the discretion of the President, receive a brevet in the Regular Army equal to the highest rank held or the highest brevet received in the said volunteer forces and be commissioned accordingly as of the date of such brevet: *Provided*, That they have not already received a brevet of equal or higher grade in the Regular Army.

Army.
Officers may receive brevet for highest volunteer rank.

Proviso.
Condition.

Received by the President, February 4, 1897.

[NOTE BY THE DEPARTMENT OF STATE.—The foregoing act having been presented to the President of the United States for his approval, and not having been returned by him to the house of Congress in which it originated within the time prescribed by the Constitution of the United States, has become a law without his approval.]

CHAP. 236.—An Act To amend an Act entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," passed finally June third, eighteen hundred and ninety-six.

February 17, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," passed by the House of Representatives June second, eighteen hundred and ninety-six, and by the Senate June third, eighteen hundred and ninety-six, notwithstanding the objections of the President, be, and the same is hereby, amended by inserting on page two hundred and thirteen of the Statutes at Large, Fifty-fourth Congress, first session, after the word "War" and before the word "Provided," on the thirty-

Pacific deep-water harbor commission.
Vol. 29, p. 213.

ninth line of said page, the following language: The officer of the Navy detailed to serve on this Board shall receive from said appropriation, in addition to his mileage provided for in section fifteen hundred and sixty-six of the Revised Statutes, and notwithstanding its provisions, such a per diem allowance for subsistence as the Secretary of War may deem proper.

Per diem to naval officer.

R. S., sec. 1566, p. 260.

Approved, February 17, 1897.

February 17, 1897.

CHAP. 238.—An Act Authorizing the Cleveland Bridge Company to construct a bridge across the Arkansas River between Pawnee County, Oklahoma, and the Osage Indian Reservation.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Cleveland Bridge Company, a corporation duly organized and existing under the laws of the Territory of Oklahoma, and its successors or assigns, be, and is hereby, authorized to construct and maintain a bridge and approaches thereto across the Arkansas River between a point in Pawnee County and the Osage Indian Reservation, in the Territory of Oklahoma, on section nine, township twenty-one east, of range eight east. Said bridge shall be constructed to provide for the passage of wagons and vehicles of all kinds, for the transit of animals, foot passengers, and all kinds of commerce, travel, and communications, and said corporation may charge and receive such reasonable tolls therefor as may be permitted by the laws of the Territory of Oklahoma.

Cleveland Bridge Company may bridge Arkansas River, Okla.

Location.

Wagon and foot bridge.

SEC. 2. That the bridge constructed under this Act shall be a lawful structure, and shall be recognized as a post route, upon which no charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, and equal privileges in the use of said bridge shall be granted to all telegraph companies, and the United States shall have the right of way across said bridge and approaches for postal telegraph purposes: *Provided*, That before the construction of any bridge herein authorized is commenced the said company shall submit to the Secretary of War, for his examination and approval, a design and drawing of such bridge and a map of the location, giving sufficient information to enable the Secretary of War to fully and satisfactorily understand the subject; and unless the plan and location of such bridge are approved by the Secretary of War the structure shall not be built: *Provided further*, That any bridge constructed under authority of this Act shall at all times be so kept and managed as to offer reasonable and proper means for the passage of vessels and other water craft through or under said structure, and for the safety of vessels passing at night there shall be displayed on said bridge, from sunset to sunrise, such lights or other signals as may be prescribed by the Light-House Board.

Lawful structure and post route.

Postal telegraph.

Provisos.

Secretary of War to approve plans, etc.

Aids to navigation.

Lights, etc.

SEC. 3. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced

Commencement and completion.

within one year and completed within three years from the approval of this Act.

SEC. 4. That Congress shall have power at any time to alter, amend, or repeal this Act, or any part thereof, if in its judgment the public interests so require.

Amendment, etc.

Approved, February 17, 1897.

CHAP. 239.—An Act To authorize a survey for construction of a bridge across the Eastern Branch of the Potomac River in line with Massachusetts avenue extended eastward.

February 17, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized and directed to cause to be made, as soon as practicable, a survey, plan, and estimate of the cost of constructing a substantial wooden, iron, steel, or masonry bridge across the Eastern Branch of the Potomac River, in the District of Columbia, and the necessary approaches thereto, such bridge to begin for its westward end at a suitable point on the Government reservation in line with Massachusetts avenue extended eastward, and extending thence across the said river to a suitable point in the line of Massachusetts avenue extended, for its eastern end, such bridge when constructed to be maintained as a free bridge for travel, and to be of such strength and dimensions as to accommodate the ordinary traffic which passes over an ordinary highway, and also the tracks and traffic of any street railway or railways employing horses or electric or mechanical motors (not steam-operated motors) for the propulsion of its cars, which may hereafter be granted the right to cross such bridge by the authorities vested with such power, and to report thereon to the Congress of the United States on the first Monday of December, eighteen hundred and ninety-seven; and that the sum of three thousand dollars be, and the same is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for such survey, plan, and estimate, and such contingencies as are necessarily incident thereto, such sum of money to be immediately available upon the passage of this Act.

Eastern Branch, Potomac River, D. C. Survey directed for bridge across, in line with Massachusetts avenue.

Report.

Appropriation.

Approved, February 17, 1897.

CHAP. 240.—An Act To authorize the construction by the Duluth and North Dakota Railroad Company of two bridges across the Red River of the North between the States of Minnesota and North Dakota.

February 17, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Duluth and North Dakota Railroad Company, a corporation duly created and existing under the law of the State of North Dakota, its successors or assigns, be, and it is hereby, authorized to construct and maintain a bridge and approaches thereto across the Red River of the North at two points on said river, as follows:

Duluth and North Dakota Railroad Company may bridge Red River of the North, North Dakota.

Location.

One of said bridges shall be located at or near Grand Forks, in the county of Grand Forks and State of North Dakota, and the other of said bridges shall be located at or near Acton, in Walsh County, or at or near Drayton, in Pembina County, both in North Dakota, or at some convenient point between said towns. Said bridges shall be constructed to provide for the passage of railway trains, and, at the option of said corporation, may be so constructed as to provide for the passage of wagons and vehicles of all kinds, animals, and foot passengers, for such reasonable rates of toll as may be approved by the Secretary of War.

Railway, etc., bridge.

Secretary of War to approve plans, etc.

SEC. 2. That the bridges herein authorized shall be built and located under and in accordance with such regulations for the security of navigation as the Secretary of War shall prescribe; and to secure that object the said company shall submit to the Secretary of War, for his examination and approval, drawings showing the plan and location of said bridges; said drawings to give for the space of one-half mile above and one-half mile below the proposed location the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current at all stages, soundings accurately showing the bed of the stream, and such other information as may be required for a full and satisfactory understanding of the subject; and until the plan and location of the bridges are approved by the Secretary of War the bridges shall not be commenced or built; and any change in the plans of said bridges, either before or after construction, shall be subject to the approval of the Secretary of War; and any change in said bridges during or after construction which the Secretary of War may require in the interest of navigation shall be made by the said company at its own expense.

Changes.

Aids to navigation.

SEC. 3. That the said bridges shall at all times be so kept and managed as to offer reasonable and proper means for the passage of vessels and other crafts through or under said structures; and if said bridges be built as drawbridges the draws shall be opened promptly upon reasonable signal for the passage of boats or other crafts; and whatever kind of bridge is constructed the said company shall maintain at its own expense, from sunset to sunrise, such lights or other signals on said bridges as the Light-House Board shall prescribe.

Draws.

Lights, etc.

Lawful structure and post route.

SEC. 4. That any bridge built under this Act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops and munitions of war of the United States, or passengers or freight over said bridge than the rate per mile paid for the transportation over the railroads or public highways leading to said bridge; and it shall enjoy the rights and privileges of other post roads of the United States; and equal privileges in the use of said bridges shall be granted to all telegraph and telephone companies, and the United States shall have the right of way across said bridges and their approaches for said postal telegraph purposes.

Postal telegraph.

Use by railroad companies.

SEC. 5. That all railroad companies desiring the use of said bridges and their approaches shall have and be entitled to equal rights and privileges relative to the passage of trains over the same upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridges and the several railroad companies, or any of them, desiring such use shall fail to agree upon the sum or sums to be paid, or upon rules and conditions to which each shall conform in using said bridges and approaches, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Compensation.

Commencement and completion.

SEC. 6. That this Act shall be null and void if actual construction of the bridges herein authorized be not commenced within one year and completed within three years from the date hereof: *Provided*, That the commencement and completion of either of said bridges in accordance with this Act shall be deemed a compliance with this section, as to such bridge, and the rights of said company with respect to such bridge, shall not be affected by failure to commence or complete the other of said bridges.

Proviso.
Separate liability of each bridge.

Amendment, etc.

SEC. 7. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Approved, February 17, 1897.

February 17, 1897.

CHAP. 242.—An Act To amend an Act entitled "An Act to authorize the Chattanooga Western Railway Company to construct a bridge across the Tennessee River near Chattanooga," giving the said company more time in which to begin and complete said bridge.

Bridge across Tennessee River at Chattanooga, Tenn.
Vol. 28, p. 30.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section five of an Act entitled "An Act to authorize the Chattanooga Western Railway Company to construct a bridge across the Tennessee River near Chattanooga," approved January twenty-seventh, eighteen hundred and ninety-four, be, and the same is hereby, amended to read as follows:

Time extended for construction.

"SEC. 5. That the right to alter, amend, or repeal this Act is hereby expressly reserved; and any alterations or changes that may be required by Congress in the bridge constructed under this Act, or its entire removal, shall be made by the corporation owning or controlling the same at its own expense. Furthermore, if the construction of said bridge shall not be commenced before January first, eighteen hundred and ninety-eight, and completed before January first, nineteen hundred and one, all privileges conferred hereby and this Act shall become null and void."

Approved, February 17, 1897.

February 17, 1897.

CHAP. 243.—An Act To amend an act authorizing the West Braddock Bridge Company to construct a bridge over the Monongahela River from the borough of Rankin to Mifflin Township.

Bridge across Monongahela River, Allegheny County, Pa.
Vol. 28, p. 58.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section eight of an Act to authorize the West Braddock Bridge Company to construct a bridge over the Monongahela River from the borough of Rankin to Mifflin Township, approved April twenty-first, eighteen hundred and ninety-four, be, and the same is hereby, amended so as to read as follows:

Time extended for construction.

"SEC. 8. That this Act shall be null and void if actual construction of the bridge authorized to be built be not commenced and completed within one year from the date of the approval of the plans of said bridge by the Secretary of War, and the authority to construct said bridge in accordance with said plans is hereby extended and confirmed in accordance with the provisions of said original Act as hereby amended."

Approved, February 17, 1897.

February 17, 1897.

CHAP. 244.—An Act Relating to the improvement of Eastchester Creek, State of New York.

Eastchester Creek, New York.
Expenditure of appropriation for improving.
Vol. 28, p. 347.
Vol. 29, p. 216.

Be it inacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized, in his discretion, to expend the whole or any portion of any appropriation heretofore made for the improvement of Eastchester Creek, in the State of New York, in accordance with the surveys and report for such improvement, upon that portion of the improvement included in recent surveys extending the improvement to the head of tide water.

Approved, February 17, 1897.

February 19, 1897.

CHAP. 265.—An Act Making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, and for other purposes.

Legislative, executive, and judicial expenses appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, in full compensation for the service of the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, for the objects hereinafter expressed, namely:

* * * * *

War Department.

WAR DEPARTMENT.

* * * * *

Engineer Office.

OFFICE OF THE CHIEF OF ENGINEERS: For chief clerk, two thousand dollars; four clerks of class four; two clerks of class three; two clerks of class two; three clerks of class one; one clerk, one thousand dollars; one assistant messenger; and two laborers; in all, twenty-one thousand eight hundred and forty dollars.

Draftsmen, etc.

And the services of skilled draftsmen, civil engineers, and such other services as the Secretary of War may deem necessary, may be employed only in the office of the Chief of Engineers to carry into effect the various appropriations for rivers and harbors, fortifications, and surveys to be paid from such appropriations: *Provided*, That the expenditures on this account for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, shall not exceed seventy-two thousand dollars; and that the Secretary of War shall each year, in the annual estimates, report to Congress the number of persons so employed and the amount paid to each.

Proviso.
Limit, etc.

* * * * *

PUBLIC BUILDINGS AND GROUNDS.

Public buildings and grounds

Clerk, messenger, etc.

OFFICE OF PUBLIC BUILDINGS AND GROUNDS: For one clerk, one thousand six hundred dollars; one messenger; public gardener, one thousand eight hundred dollars; in all, four thousand two hundred and forty dollars.

Overseers, etc.

For overseers, draftsmen, foremen, gardeners, mechanics, and laborers employed in the public grounds, twenty-eight thousand dollars.

Watchmen.

For day watchmen as follows: One in Franklin Park; one in Lafayette Park; two in Smithsonian Grounds; one in Judiciary Park; one in Lincoln Park and adjacent reservations; one at Iowa Circle; one at Thomas Circle and neighboring reservations; one at Washington Circle and neighboring reservations; one at Dupont Circle and neighboring reservations; one at McPherson and Farragut parks; one at Stanton Park and neighboring reservations; two at Henry and Seaton parks and reservations east of Botanic Garden; one at Mount Vernon Park and adjacent reservations; one for the greenhouses and nursery; one at grounds south of Executive Mansion; one at Garfield Park; eighteen in all, at six hundred and sixty dollars each, eleven thousand eight hundred and eighty dollars.

For night watchmen as follows: Two in Smithsonian Grounds; one in Judiciary Park; one in Henry and Seaton parks and reservations east of Botanic Garden; and one in Garfield Park; five in all, at seven hundred and twenty dollars each, three thousand six hundred dollars.

Wakefield, Va.

For watchman for the care of the monument and dock at Wakefield, Virginia, the birthplace of Washington, three hundred dollars.

Contingent expenses.

For contingent and incidental expenses, five hundred dollars.

* * * * *

Approved, February 19, 1897.

February 24, 1897.

CHAP. 311.—An Act To provide for the relief of certain officers and enlisted men of the volunteer forces.

Volunteers.

Officers to take rank by terms of appointment.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That any person who was duly appointed or commissioned to be an officer of the volunteer service during the war of the rebellion, and who was subject to the mustering regulations at the time applied to members of the volunteer service shall be held and considered to have been mustered into the service of the United States in the grade named in his appointment or commission from the date from which he was to take rank under and by the terms of his said appointment or commission, whether the same was actually received by him or not, and shall be entitled to pay, emoluments, and pension as if actually mustered at that date: *Provided*, That at the date from which he was to take rank by the terms of his said appointment or commission there was a vacancy to which he could be so appointed or commissioned, and his command had either been recruited to the minimum number required by law and the regulations of the War Department, or had been assigned to duty in the field, and that he was actually performing the duties of the grade to which he was so appointed or commissioned; or if not so performing such duties, then he shall be held and considered to have been mustered into service and to be entitled to the benefits of such muster from such time after the date of rank given in his commission as he may have actually entered upon such duties: *Provided further*, That any person held as a prisoner of war, or who may have been absent by reason of wounds, or in hospital by reason of disability received in the service in the line of duty, at the date of issue of his appointment or commission, if a vacancy existed for him in the grade to which so appointed or commissioned, shall be entitled to all the benefits to which he would have been entitled under this Act if he had been actually performing the duties of the grade to which he was appointed or commissioned at said date: *Provided further*, That this Act shall be construed to apply only in those cases where the commission bears date prior to June twentieth, eighteen hundred and sixty-three, or after that date when the commands of the persons appointed or commissioned were not below the minimum number required by then existing laws and regulations: *And provided further*, That the pay and allowances actually received for the period covered by the recognition extended under this Act shall be deducted from the sums otherwise to be paid thereunder.

Pay, etc.

Provisos.

To date from actual performance of duties, etc.

Prisoners of war, or disabled.

Limitation.

Deduction of pay received.

Allowance to heirs.

SEC. 2. That the heirs or legal representatives of any person whose muster into service shall be recognized and established under the terms of this Act shall be entitled to receive the arrears of pay and emoluments due, and the pension, if any, authorized by law, for the grade to which recognition shall be so extended.

No deductions if services performed.

SEC. 3. That the pay and allowances of any rank or grade paid to and received by any military or naval officer in good faith for services actually performed by such officer in such rank or grade during the war of the rebellion, other than as directed in the fourth proviso of the first section of this Act, shall not be charged to or recovered back from such officer because of any defect in the title of such officer to the office, rank, or grade in which such services were so actually performed.

Repeal, etc.

SEC. 4. That all acts and parts of acts inconsistent with the provisions of this Act be, and the same are hereby, repealed.

Approved, February 24, 1897.

February 25, 1897.

CHAP. 316.—An Act To prevent the purchasing of or speculating in claims against the the Federal Government by United States officers.

United States Courts. Purchase of claims for fees, etc., by officials prohibited.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall hereafter be unlawful for any United States marshal or deputy marshal, or any clerk or deputy clerk of any court of the United States or of any Territory thereof, or any United States attorney or assistant attorney, or any United States judge, or United States commissioner, or other person holding any office, employment, or position of trust or profit under the Government of the United States to purchase, at less than the full face value thereof, either directly or indirectly, any claim for fee, mileage, or expenses of any witness, juror, deputy marshal, or of any other officer of court whatsoever against the United States Government.

Penalty.

SEC. 2. That any person who shall violate this Act shall be deemed guilty of a misdemeanor and, upon conviction, shall be fined not exceeding one thousand dollars.

Approved, February 25, 1897.

February 25, 1897.

CHAP. 317.—An Act To authorize the construction of a bridge over the Monongahela River from the city of McKeesport to the township of Mifflin, Allegheny County, Pennsylvania.

Mifflin Bridge Company may bridge Monongahela River, McKeesport, Pa.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Mifflin Bridge Company, a corporation duly organized under the laws of the Commonwealth of Pennsylvania, its successors, lessees, and assigns, be, and are hereby, authorized and empowered to construct, maintain, and operate a bridge over the Monongahela River from a point in the city of McKeesport, Allegheny County, Pennsylvania, between Market and Walnut streets, to a point on the opposite side of said river on the property of the heirs of Colonel William Neal, in Mifflin Township, said county.

Street railway, etc., bridge.

SEC. 2. That said bridge may be constructed to provide for the passage of street cars, wagons, and vehicles of all kinds, and for the transit of animals, foot passengers, and of commercial travel and communication, and the said corporation may charge and receive reasonable tolls therefor, *Proviso.* Use by street railway companies.

to be approved by the Secretary of War: *Provided*, That any street-car companies desiring the use of said bridge shall have and be entitled to equal privileges in the passage of cars over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use, and in case of disagreement as to the terms and conditions of such use all matters at issue shall be determined by the Secretary of War upon proper hearing of the proofs and allegations.

Lawful structure and post route.

Provisos. Postal telegraph.

Submission of plans.

SEC. 3. That any bridge built under this Act and subject to its limitations shall be a lawful structure and shall be recognized and known as a post route, and it shall enjoy the rights and privileges of other post roads in the United States: *Provided*, That the United States may construct a postal telegraph over said bridge without charge therefor: *And provided also*, That the said Mifflin Bridge Company shall not commence the construction of its bridge, bridge piers, abutments, causeways, and other works over or in said Monongahela River until the location and plan of same shall have been submitted to and approved by the Secretary of War.

Secretary of War to approve plans, etc.

Changes.

Proviso. Channel span.

SEC. 4. That any bridge authorized to be constructed under this Act shall be located and built under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the said Secretary of War for his examination and approval a design and drawing of the bridge and a map of the location, giving for the space of one-half mile above and one-half mile below the proposed location the high and low water lines upon the banks of the river, the direction and strength of the currents at high and low water, with the soundings accurately showing the bed of the stream and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for the full and satisfactory understanding of the subject. And until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built. And should any change be made in the plan of said bridge during the progress of its construction, such change shall be submitted for the approval of the Secretary of War: *Provided*, That the channel span of said bridge shall not be less than five hundred feet in length in the clear, and the clear height of the superstructure shall not be less than fifty-three feet above the level of the water at pool full in said river.

Aids to navigation.

Lights, etc.

Changes.

SEC. 5. That said bridge herein authorized to be constructed shall be so kept and managed at all times as to afford proper means and ways for the passage of vessels, barges, or rafts, both by day and by night. And there shall be displayed on said bridge, by the owners thereof, from sunset to sunrise, such lights and other signals as the Light-House Board may prescribe. And such changes shall be made from time to time in the construction of said bridge as the Secretary of War may direct, at the expense of said bridge company, in order the more effectually to preserve the free navigation of said river.

Commencement and completion.

SEC. 6. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of the approval of this Act.

Amendment, etc.

SEC. 7. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Approved, February 25, 1897.

February 26, 1897.

CHAP. 333.—An Act To provide for closing the crevasse in Pass a Loutre, one of the outlets of the Mississippi River.

Appropriation for closing crevasse in Pass a Loutre.

Mississippi River.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of two hundred and fifty thousand dollars, or so much thereof as may be necessary, be, and is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, to close the crevasse in Pass a Loutre of the Mississippi River, to be expended under the direction and according to the plans and specifications of the Secretary of War.

Contracts with James B. Eads not impaired.

Vol. 18, p. 463; Vol. 20, pp. 168, 376.

Proviso.

Liability of estate of James B. Eads, referred to Attorney-General.

Money to be withheld.

SEC. 2. That nothing herein contained shall be held or construed to destroy or impair any right or rights of the United States arising under the Acts of March third, eighteen hundred and seventy-five, June nineteenth, eighteen hundred and seventy-eight, and March third, eighteen hundred and seventy-nine, containing the contract or contracts between James B. Eads and such persons as might become associated with him and the United States, or to release the legal representatives of said James B. Eads or other persons associated with him, jointly or severally, from any obligation, expressed or implied, arising under and from said Acts or other Acts pertaining thereto: *Provided,* That nothing herein contained shall be held or construed to release in anywise the executors of the estate of James B. Eads as such executors, or the associates of said James B. Eads, jointly or severally, in whole or in part, from any liability which now exists, if any such liability does exist, for a failure to close said Pass a Loutre crevasse, and the question of such liability shall be referred to the Attorney-General for his decision; and should the decision of the Attorney-General, after a full hearing to both parties, be to the effect that the responsibility for the closing of the said Pass a Loutre crevasse rests upon the executors of the estate of James B. Eads as such executors, and the associates of the said James B. Eads, jointly or severally, under existing laws, then upon the completion of the twenty years' contract for the maintenance of the channel in South Pass outlet of the Mississippi River, as the same now exists, the Secretary of War shall withhold so much of the money then to be paid to the executors of the estate of James B. Eads as such executors, or to the associates of the said

James B. Eads, jointly or severally, as shall have been expended under the authority of this Act, until the same shall be judicially or otherwise legally determined in favor of such executors as such executors, or said associates of James B. Eads, jointly or severally.

Approved, February 26, 1897.

February 26, 1897.

CHAP. 334.—An Act To authorize the Montgomery, Hayneville and Camden Railroad Company to construct and maintain a bridge across the Alabama River between Lower Peachtree and Prairie Bluff, Alabama.

Montgomery, Hayneville and Camden Railroad Company may bridge Alabama River, Alabama.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Montgomery, Hayneville and Camden Railroad Company, a corporation created and existing under an act of the general assembly of the State of Alabama, be, and is hereby, authorized to construct and maintain a railroad bridge, for the passage of railway engines and cars across the Alabama River at such point as may be selected by such company, between Lower Peachtree and Prairie Bluff, in the State of Alabama, said bridge to be so constructed as not to obstruct the navigation of said river and to be provided with a suitable draw: *Provided*, That any bridge constructed under this Act and according to its limitations shall be a lawful structure, and shall be known and recognized as a post route, and the same is hereby declared to be a post route, and the United States shall have the right of way for a postal telegraph across said bridge: *Provided also*, That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains or cars over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case of any disagreement between the parties in regard to the terms of such use or the sums to be paid all matters at issue shall be determined by the Secretary of War upon hearing the allegations and proofs submitted to him.

Location.

Provisos.

Lawful structure and post route.

Postal telegraph.

Use by other companies.

Compensation.

Secretary of War to approve plans, etc.

SEC. 2. That the bridge authorized to be constructed under this Act shall be located and built under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawing of the proposed bridge and a map of the location, giving for the space of one-half mile above and one-half mile below the proposed location the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the currents, and the soundings, accurately showing the bed of the stream, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War no work upon the bridge shall be commenced, and should any change be made in the plan of said bridge during the progress of construction such change shall be subject to the approval of the Secretary of War.

Amendment, etc.

SEC. 3. That Congress reserves the right to alter, amend, or repeal this Act at any time, and that if at any time navigation of said river shall in any manner be obstructed or impaired by the said bridge the Secretary of War shall have authority, and it shall be his duty, to require the said bridge company to alter and change the said bridge, at its own expense, in such manner as may be proper to secure free and complete navigation without impediment.

Changes.

Draw.

Lights, etc.

SEC. 4. That the draw provided for the bridge herein authorized to be constructed shall be opened promptly, upon reasonable signal, for the passing of boats; and said company or corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

Telegraph and telephone lines.

Commencement and completion.

SEC. 5. That all telephone and telegraph companies shall be granted equal rights and privileges in the construction and operation of their lines across said bridge; and if actual construction of the bridge herein authorized shall not be commenced within one year from the passage of this Act, and be completed within three years from same date, the rights and privileges hereby granted shall cease and be determined.

Approved, February 26, 1897.

March 2, 1897.

CHAP. 357.—An Act To authorize the construction and maintenance of a bridge across the Saint Lawrence River.

Northern New York Railroad Company may bridge Saint Lawrence River, Hogansburg, N. Y.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Northern New York Railroad Company, a corporation organized and created under and by virtue of the laws of the State of New York, or such railway or bridge company now or hereafter incorporated under the laws of said State or of the Dominion of Canada as the said Northern New York Railroad Company or its assigns may unite with, be, and it hereby is, authorized and empowered to construct, own, maintain, and operate a bridge and approaches thereto across the Saint Lawrence River, from a point on the right or southerly bank thereof at or near the village of Hogansburg, in the county of Franklin, in the State of New York, to a point on the Island of Cornwall near the town of Cornwall, in the county of Cornwall and Stormont, Province of Ontario, in the Dominion of Canada, at such point as may be most convenient to said corporation to unite and connect the railroad built or to be built by it in the said State of New York with any railroad or bridge that may be constructed by any person or corporation in the said Dominion of Canada. Said bridge shall be constructed to provide for the passage of railway trains and, at the option of the said corporation, may be used for the passage of vehicles, animals, and foot passengers upon such reasonable rates of toll as may be fixed and from time to time revised by the Secretary of War of the United States. Said bridge when

Railway, etc., bridge.

Toll.

Lawful structure and post route. Proviso. Consent of Canada.

completed shall be deemed and taken to be a lawful structure, and shall be recognized and known as a post route for the United States mails: *Provided*, That before the construction of the said bridge shall be begun all proper and requisite authority therefor shall be obtained from the government of the Dominion of Canada.

Secretary of War to approve plans, etc.

SEC. 2. That the bridge herein provided for shall be subject in its location, plan, and construction to the supervision of the Secretary of War of the United States, to whom the plans and specifications relative thereto shall be submitted for approval; and until the said location and plan of construction of said bridge hereby authorized to be constructed are approved by the Secretary of War, the said bridge shall not be commenced or built; and no change shall be made in the plan of such bridge during the progress of construction or after completion thereof unless by the consent and with the approval of the Secretary of War first obtained. The said bridge shall be so located and constructed as not to obstruct the navigation of the main channel of the river. The said company shall submit to the Secretary of War, for his examination and approval, drawings of the said bridge and piers, together with a map of the location, showing for the space of at least one mile below and one mile above the proposed location the topography of the banks of the river, the shore lines at high and low water, the location of the channel, together with the direction and strength of the current at ordinary high and low stages, and the soundings of the river bed, and shall furnish such further information as may be required by the Secretary of War for a full understanding of the subject. The corporation owning or operating the said bridge shall maintain at its own expense, from sunset to sunrise, such lights or other signals thereupon as the United States Light-House Board may require.

Unobstructed navigation.

Lights.

Use by other companies.

SEC. 3. That all railway companies desiring to use the said bridge shall have and be entitled to equal rights and privileges in the passage of the same and in the use of the machinery and fixtures thereof, and of the approaches thereto, under and upon such terms as may be from time to time agreed upon between such railway companies and the persons or corporation owning or operating the said bridge, and in case they shall not agree upon the same, then upon such terms and conditions as may be prescribed by the district court of the United States for the northern district of New York, after hearing the allegations and proofs of the parties in due form presented.

Terms.

Commencement and completion.

SEC. 4. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of approval hereof.

Amendment, etc. Removal.

SEC. 5. That the right to alter, amend, or repeal this Act is hereby expressly reserved; and the right to require the entire removal of the bridge constructed under the provisions of this Act, at the expense of the owners thereof, whenever Congress shall decide that the public interests require it, is also expressly reserved.

Approved, March 2, 1897.

March 2, 1897.

CHAP. 362.—An Act Making appropriations for the support of the Army for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight.

Army appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and they are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the support of the Army for the year ending June thirtieth, eighteen hundred and ninety-eight:

* * * * *

FOR PAY OF THE GENERAL STAFF.

General staff.

* * * * *

Corps of Engineers.

THE CORPS OF ENGINEERS: For pay of officers in the Corps of Engineers, as now authorized and provided by law, two hundred and thirty-nine thousand five hundred dollars;

Longevity.

For additional pay to such officers for length of service, to be paid with their current monthly pay, seventy-one thousand eight hundred and fifty dollars;

In all, three hundred and eleven thousand three hundred and fifty dollars.

* * * * *

Pay to officer, public buildings and grounds, D. C.

Additional pay to officer in charge of public buildings and grounds at Washington, District of Columbia, in addition to pay as major, one thousand dollars.

* * * * *

Engineer Department.

ENGINEER DEPARTMENT.

Incidental expenses.

ENGINEER DEPOT AT WILLETS POINT, NEW YORK: For incidental expenses of the depot, including fuel, lights, chemicals, stationery, hardware, extra-duty pay to soldiers necessarily employed for periods not less than ten days as artificers on work in addition to and not strictly in the line of their military duties, such as carpenters, blacksmiths, draftsmen, printers, lithographers, photographers, engine drivers, teamsters, wheelwrights, masons, machinists, painters, overseers, laborers, repairs of, and for materials to repair, public buildings, machinery, and unforeseen expenses, five thousand dollars;

Materials.

For the purchase of material for use of United States Engineer School and for instruction of engineer troops at Willets Point in their special duties as sappers and miners; for land and submarine mines, pontoniers, torpedo drill, and signaling, one thousand five hundred dollars;

Instruments.

For purchase and repair of instruments, to be issued to officers of the Corps of Engineers and to officers detailed and on duty as acting engineer officers, for use on public works and surveys, three thousand dollars;

Library.

LIBRARY OF THE UNITED STATES ENGINEER SCHOOL: For purchase and binding of professional works of recent date treating of military and civil engineering and kindred scientific subjects, five hundred dollars;

In all, ten thousand dollars.

* * * * *

Approved, March 2, 1897.

March 3, 1897.

CHAP. 373.—An Act To amend an Act entitled "An Act to authorize the Montgomery Bridge Company to construct and maintain a bridge across the Alabama River near the city of Montgomery, Alabama," approved March first, eighteen hundred and ninety-three.

Bridge over Alabama River, Montgomery, Ala.
Vol. 27, p. 528.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section six of an Act approved March first, eighteen hundred and ninety-three, to authorize the Montgomery Bridge Company to construct and maintain a bridge across the Alabama River near Montgomery, Alabama, be, and is hereby, amended to read as follows:

Time for construction extended.

"SEC. 6. That all telephone and telegraph companies shall be granted equal rights and privileges in the construction and operation of their lines across said bridge; and if actual construction of the bridge herein authorized shall not be commenced within one year from March first, eighteen hundred and ninety-seven, and be completed within three years from same date, the rights and privileges hereby granted shall cease and be determined.

Approved, March 3, 1897.

March 3, 1897.

CHAP. 375.—An Act Declaring the Potomac Flats a public park, under the name of the Potomac Park.

District of Columbia.
Potomac Park established embracing the Potomac Flats.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the entire area formerly known as the Potomac Flats and now being reclaimed, together with the tidal reservoirs, be, and the same are hereby, made and declared a public park, under the name of the Potomac Park, and to be forever held and used as a park for the recreation and pleasure of the people.

Approved, March 3, 1897.

March 3, 1897.

CHAP. 381.—An Act To authorize the construction of a bridge across the Yazoo River at or near the city of Greenwood, in Leflore County, in the State of Mississippi.

Leflore County may bridge Yazoo River, Greenwood, Miss.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the board of supervisors of Leflore County, in the State of Mississippi, be, and is hereby, authorized to construct and maintain a bridge and approaches thereto across the Yazoo River at or within five miles above or below Greenwood, in the State of Mississippi. Said bridge shall be constructed to provide for the passage of wagons and vehicles of all kinds, animals, foot passengers, and for all road travel, for such reasonable rates of toll and under such reasonable rules and regulations as may be prescribed by said board of supervisors and approved by the Secretary of War.

Wagon and foot bridge.

Toll.

Lawful structure and post route.

SEC. 2. That any bridge built under this Act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which no charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, and it shall enjoy the rights and privilege of other post roads in the United States; and an equal privilege in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge and its approaches for postal telegraph purposes. Postal telegraph.

SEC. 3. That said bridge shall be constructed as a wagon bridge, and shall contain a drawspan giving a clear opening of a width to be determined by the Secretary of War, which drawspan shall be maintained over the main channel of the river at an accessible and navigable point, and said bridge other than the drawspan shall be at right angles to the current of the river at high water: *Provided*, That said draw shall be opened promptly by said company upon reasonable signal for the passage of boats and rafts; and said board of supervisors shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. No bridge shall be erected or maintained under the authority of this Act which shall at any time unreasonably obstruct the free navigation of said river; and if any bridge erected under such authority shall, in the opinion of the Secretary of War, unreasonably obstruct such navigation, he is hereby authorized to cause the entire removal thereof or such change or alteration of said bridge to be made as will effectually obviate such obstruction, and all such alterations shall be made and all such obstructions shall be removed at the expense of the owner or owners of said bridge; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, caused or alleged to be caused by said bridge, the case may be brought in the district court of the United States of the State of Mississippi in whose jurisdiction any portion of said obstruction or bridge may be located: *Provided further*, That nothing in this Act shall be so construed as to repeal or modify any of the provisions of the law now existing in reference to the protection of the navigation of rivers, or to exempt this bridge from the operations of the same. Drawspan. *Provisos.* Opening draws. Lights, etc. Unobstructed navigation. Changes. Litigation. Existing laws not affected.

SEC. 4. That any bridge authorized to be constructed under this Act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said board of supervisors shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location, giving for the space of one-half mile above and one-half mile below the proposed location the high and low water lines upon the banks of the river, the direction and strength of the currents at low and at high water, with the soundings accurately showing the bed of the stream, and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall fur- Secretary of War to approve plans, etc.

nish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built, and should any change be made in the plans of said bridge during the progress of its construction such changes shall be subject to the approval of the Secretary of War.

Commencement and completion.

SEC. 5. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof: *Provided*, That Congress reserves the right to alter, amend, or repeal this Act whenever the public interests so require.

Proviso.
Amendment, etc.

Approved, March 3, 1897.

March 3, 1897.

CHAP. 384.—An Act Making appropriations for fortifications and other works of defense, for the armament thereof, for the procurement of heavy ordnance for trial and service, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sums of money herein provided for be, and the same are hereby, appropriated, out of any moneys in the Treasury not otherwise appropriated, to be available until expended, namely:

Fortifications appropriations.

Gun and mortar batteries.

GUN AND MORTAR BATTERIES: For construction of gun and mortar batteries, one million three hundred and forty-one thousand three hundred and thirty-three dollars.

Work under contracts.
Vol. 29, p. 257.

For materials and work for construction of fortifications, to meet contracts authorized by the fortification appropriation Act approved June sixth, eighteen hundred and ninety-six, two million five hundred thousand dollars.

Plans for care, etc., to be submitted.

That prior to any expenditure of money for the construction of necessary buildings connected with the new fortifications, except that already authorized, the Secretary of War shall report to Congress on or before December sixth, eighteen hundred and ninety-seven, the most practicable and economical plan for the care and preservation of the fortifications and their armament, said plans to be based upon the authorized strength of the artillery force of the Army.

Sites, etc.

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES: For the procurement of land, or right pertaining thereto, needed for the site, location, construction, or prosecution of works for fortifications and coast defenses, three hundred thousand dollars.

Preservation, etc.

PRESERVATION AND REPAIR OF FORTIFICATIONS: For the protection, preservation, and repair of fortifications for which there may be no special appropriation available, one hundred thousand dollars.

Plans.

For preparation of plans for fortifications, five thousand dollars.

SEA WALLS AND EMBANKMENTS: For construction of sea walls and embankments, thirty-three thousand dollars. Sea walls.

For construction of a riprap wall for protection of the eastern beach of United States lands at Sandy Hook, New Jersey, seventy-five thousand dollars. Sandy Hook, N. J.

TORPEDOES FOR HARBOR DEFENSE: For the purchase of submarine mines and necessary appliances to operate them for closing the channels leading to our principal seaports, needful casemates, cable galleries, and so forth, to render it possible to operate submarine mines, one hundred and fifty thousand dollars. Torpedoes for harbor defense.

* * * * *

That all material purchased under the foregoing provisions of this Act shall be of American manufacture, except in cases when, in the judgment of the Secretary of War, it is to the manifest interest of the United States to make purchases abroad, which material shall be admitted free of duty. Purchases to be of American manufacture. Exception.

Approved, March 3, 1897.

CHAP. 387.—An Act Making appropriations to provide for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, and for other purposes. March 3, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the half of the following sums named, respectively, is hereby appropriated, out of any money in the Treasury not otherwise appropriated, and the other half out of the revenues of the District of Columbia, for the purposes following, being for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, namely: District of Columbia appropriations. Half from District revenues.

* * * * *

BRIDGES.

Bridges.

* * * * *

That the Chief of Engineers of the Army shall report to Congress at its next regular session plans for and the cost of erecting a stone arch bridge, and also a steel bridge with stone foundations, over Rock Creek on the line of Massachusetts avenue extended, the full width of said avenue, and for this purpose the sum of two thousand dollars, or so much thereof as may be necessary, is hereby appropriated. Rock Creek. Report on cost of steel bridge, Massachusetts avenue extended.

WASHINGTON AQUEDUCT.

Washington Aqueduct.

For engineering, maintenance, and general repairs, twenty-one thousand dollars. Maintenance.

For constructing new telephone line between office and Great Falls, five thousand dollars. Telephone line.

* * * * *

Approved, March 3, 1897.

March 3, 1897.

CHAP. 388.—An Act Authorizing the construction of a bridge over the Mississippi River to the city of Saint Louis, in the State of Missouri, from some suitable point between the north line of Saint Clair County, Illinois, and the southwest line of said county.

East St. Louis and St. Louis Bridge and Construction Company may bridge Mississippi River, St. Louis, Mo.

Provisos.

Board of Engineers to report on plans, etc.

Hearings.

Restriction on location.

Railway, etc., bridge.

Use by street railways.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the consent of Congress is hereby given to the East Saint Louis and Saint Louis Bridge and Construction Company, of the city of East Saint Louis, of the county of Saint Clair and State of Illinois, a corporation organized under the laws of the State of Illinois, its assigns, successors, grantees, mortgagees, representatives, and successors in interest, to build, own, operate, and maintain a bridge and approaches thereto, as hereinafter described, across the Mississippi River, from some point suitable to the interests of navigation between the north line of Saint Clair County, Illinois, and the southwest line of said county, to the city of Saint Louis, State of Missouri: *Provided*, That the plan and location of the said bridge, so far as the interests of navigation are concerned, shall be recommended by a board of three United States engineers appointed by the Secretary of War and shall be approved by the Secretary of War. And it shall be the duty of the said board to give a public hearing in the city of Saint Louis to all parties interested in the construction of said bridge or in the navigation of the river whenever the design and drawings of said bridge and maps of location shall have been submitted to the Secretary of War as herein provided. Said board to give reasonable notice of time and place of such hearing and report its recommendations to the Secretary of War as soon thereafter as may be expedient: *Provided also*, That said proposed bridge shall not be located within three-fourths of one mile of any bridge already constructed across said river. Said bridge shall be constructed for the purpose of providing for the passage of wagons, vehicles, street cars, animals, and foot passengers, and shall be constructed of sufficient strength and dimensions to provide for the passage over it of railway passenger and freight trains and the accommodation of double tracks therefor, and shall be deemed and taken as a public highway for the purposes named only, subject to the provisions hereinafter set forth: *Provided*, That street-railway companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of cars over the same and over the approaches thereto, and in case the owner or owners of said bridge and the street-railway companies, or any one of them, desiring such use shall fail to agree upon the rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon hearing the allegations and proofs of the parties in question.

Lawful structure and post route.

SEC. 2. That any bridge built under this Act and subject to its limitations shall be a lawful structure and shall be recognized and known as a post route, upon which also no charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the

United States, and it shall enjoy the rights and privileges of other post roads in the United States; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies, and the United States shall have the right of way across said bridge and its approaches for postal telegraphic purposes.

Postal telegraph.

SEC. 3. That in case the said bridge shall be built below the bridge heretofore constructed and known as the Eads Bridge, it shall be built with an unbroken and continuous single span, and the lowest part of said span shall not be of less elevation in any case than seventy-five feet above the Saint Louis City directrix; and in case the said bridge shall be built above the said Eads Bridge there shall be at least three channel spans of not less than five hundred feet clear width, each measured at right angles to the current at any and all stages of water; and the lowest part of said span shall not be of less elevation in any case than fifty feet above the Saint Louis City directrix plus the slope of the river from the foot of Walnut street, in the city of Saint Louis, to the point where the bridge shall be built; and the piers of said bridge shall be parallel with the current of the river.

Construction.

Below Eads Bridge.

Above Eads Bridge.

Spans.

SEC. 4. That the piers of all high-channel spans shall be built parallel with the current of the river at the stage of water which is most important for navigation; and riprapping or other protection for imperfect foundations which will materially lessen the waterway or which may injure navigation shall not be employed in the channel ways of the high spans, and piers which will produce cross currents or bars dangerous to navigation shall not be constructed; and if, after construction, any piers or protection walls are found to produce the above mentioned effects the nuisance shall be abated or corrected by or at the expense of the persons owning said bridge; and the approaches to the channel spans mentioned in this Act shall provide sufficient waterway for the passage of floods.

Piers.

SEC. 5. That the persons owning, controlling, or operating the bridge authorized by this Act shall maintain, at their own expense, from sunset to sunrise, throughout the year, and during heavy fogs, such lights or other signals as the Light-House Board shall prescribe, and shall also each day during the season of navigation have posted in a conspicuous place the clear headroom under the channel span on that day, the figures expressing this height to be readily visible to the naked eye from any point in the channel of the river for a stretch of four thousand feet, of which three thousand feet shall be above and one thousand feet shall be below the channel span of the bridge.

Lights, etc.

Headroom notices.

SEC. 6. That no bridge shall be erected or maintained under the authority of this Act which shall at any time substantially or materially obstruct the free navigation of said river; and if any bridge erected under such authority shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction; and all such altera-

Unobstructed navigation.

tions shall be made and all such obstructions removed at the expense of the persons owning or controlling such bridge; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, caused or alleged to be caused by said bridge, the case shall be brought and tried in the circuit court of the United States for the southern district of Illinois.

Litigation.

Secretary of War to approve plans, etc.

SEC. 7. That any bridge authorized to be constructed under this Act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge and a map of the location, giving, for a sufficient distance above and below the bridge, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current at low, medium, and high water stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be built; and should any changes be made in the plan of said bridge during the progress of construction, such changes shall be subject to the approval of the Secretary of War.

Commencement and completion.

SEC. 8. That in case the construction of the bridge authorized in this Act shall not be commenced within one year and completed within five years from the date of its approval then this Act shall be null and void.

Consolidation with other companies or pooling forbidden.

SEC. 9. That as a principal reason for giving authority to build the bridge herein contemplated is to secure reasonable rates and tolls to that class of traffic described in this Act for passage over the same, and to facilitate the transaction of business across the Mississippi River at the city of Saint Louis, the East Saint Louis and Saint Louis Bridge and Construction Company, or its successors or assigns, shall not agree or assent to the consolidation of this bridge company with any other bridge company across the Mississippi River, or to the pooling of the earnings of this bridge company with the earnings of any other bridge company across said river, nor shall any person who is or may be a director, manager, or any other officer or agent of any other bridge over said river be a director, manager, or officer or agent of the bridge herein provided for: *Provided*, That if this provision of this Act shall at any time be violated in any of these particulars, such violation shall, without legal proceeding, at once forfeit the privilege hereby granted, and said bridge shall become the property of the United States, and the Secretary of War shall take possession of the same in the name and for the use of the United States.

Proviso.
Forfeiture for violation.

Transportation.

SEC. 10. That said corporation may transport on said bridge and approaches thereto persons and property of the class described in this Act, and may allow others so to do;

and said bridge and approaches may be used for the transportation of all that class of persons and property described in this Act, under such regulations as the directors of said corporation or the parties owning the said bridge may prescribe. The corporation owning the said bridge may take, receive, and collect such rates and tolls for travel, passage, or transportation over said bridge and approaches as the directors of the corporation owning or controlling said bridge may from time to time fix and establish: *Provided*, That the rates charged for such travel, passage, or transportation shall not exceed the following, to wit: For each freight car, loaded or unloaded, three dollars; for each passenger car (exclusive of passengers riding therein), three dollars; for each passenger over five years of age crossing in any passenger car, fifteen cents; for each foot passenger over five years of age, three cents; for every person on horseback, including horse, seven cents; for every gig, buggy, carriage, cart, or wagon drawn by one animal, ten cents; for every buggy, carriage, cart, or wagon drawn by two animals, twenty cents; for every buggy, carriage, cart, or wagon drawn by three animals, twenty-five cents; for every buggy, carriage, cart, or wagon drawn by four animals, thirty cents; for every buggy, carriage, cart, or wagon drawn by more than four animals, five cents extra for each animal; for each head of cattle, horses, mules, or other animals other than those attached to vehicles, ten cents; for each head of sheep or swine, five cents. In case said corporation owning or controlling said bridge shall operate a street-car line, or permit any street-car company to operate a street-car line on said bridge and approaches, the fare for a single passenger over said bridge for persons over five years of age shall not exceed five cents.

Toll.

Proviso.
Maximum rates.

Street-car fare.

SEC. 11. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Amendment, etc.

SEC. 12. That all acts or parts of acts in conflict with this Act are hereby repealed.

Repeal.

Approved, March 3, 1897.

CHAP. 396.—An Act To repeal chapter one thousand and sixty-one, Fiftieth Congress, approved October first, eighteen hundred and eighty-eight, being an Act to grant right of way through the military reservation at Fort Morgan to the Birmingham, Mobile and Navy Cove Harbor Railway Company, and for other purposes.

March 3, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That chapter one thousand and sixty-one, Fiftieth Congress, approved October first, eighteen hundred and eighty-eight, being an Act to grant the right of way through the military reservation at Fort Morgan to the Birmingham, Mobile and Navy Cove Harbor Railway Company, and for other purposes, be, and the same is hereby, repealed.

Fort Morgan, Ala.
Right of way through reservation repealed.
Vol. 25, p. 500.

Approved, March 3, 1897.

March 3, 1897.

CHAP. 397.—An Act To revive and reenact a law to authorize the Pittsburg, Monongahela and Wheeling Railroad Company to construct a bridge over the Monongahela River.

Bridge over Monongahela River by Pittsburg, Monongahela and Wheeling Railroad Company.
Vol. 28, p. 738.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act approved March second, eighteen hundred and ninety-five, to authorize the Pittsburg, Monongahela and Wheeling Railroad Company to construct a bridge over the Monongahela River, in the State of Pennsylvania, which Act has expired by limitation, be, and is hereby, revived and re-enacted.

SEC. 2. That section eight of said Act be amended so as to read as follows:

Time for construction extended.
Vol. 28, p. 739.

"SEC. 8. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the first day of March, eighteen hundred and ninety-seven; and all the benefits of this Act shall inure and belong to the Pittsburg, Monongahela and Wheeling Railroad Company, a corporation existing under the laws of Pennsylvania, its successors or assigns."

Approved, March 3, 1897.

RESOLUTION.

February 6, 1897.

[No. 9.] Joint Resolution Authorizing the Secretary of War to grant permits to the executive committee on inaugural ceremonies for use of reservations or public spaces in city of Washington on the occasion of the inauguration of the President-elect on March fourth, eighteen hundred and ninety-seven, and so forth.

Inaugural ceremonies.
Use of reservations, etc., permitted.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War is hereby authorized to grant permits to the executive committee on inaugural ceremonies for the use of any reservations or other public spaces in the city of Washington on the occasion of the inauguration of the President-elect on the fourth day of March, eighteen hundred and ninety-seven, which, in his opinion, will inflict no serious or permanent injuries upon such reservations or public spaces or statuary thereon; and the Commissioners of the District of Columbia may designate for such and other purposes on the occasion aforesaid such streets, avenues, and sidewalks in said city of Washington as they may deem proper and necessary: *Provided, however*, That all stands or platforms that may be erected on the public spaces aforesaid shall be under the supervision of the said executive committee and in accordance with plans and designs to be approved by the Architect of the Capitol, the Commissioner of Public Buildings and Grounds, and the building inspector of the District of Columbia.

Proviso.
Stands.

* * * * *

Approved, February 6, 1897.

FIFTY-FIFTH CONGRESS, FIRST SESSION, 1897.

PUBLIC ACTS.

CHAP. 2.—An Act Making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, and for other purposes.

June 4, 1897.

Appropriations for sundry civil expenses.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, namely:

* * * * *

UNDER THE WAR DEPARTMENT.

War Department.

* * * * *

BUILDINGS AND GROUNDS IN AND AROUND WASHINGTON.

Washington, D. C.

Buildings and grounds.

For the improvement and care of public grounds as follows:

Improvement and care.

For improvement and maintenance of grounds north and south of Executive Mansion, five thousand dollars.

For ordinary care of greenhouses and nursery, two thousand dollars.

For ordinary care of Lafayette Park, one thousand dollars.

For ordinary care of Franklin Park, one thousand dollars.

For improvement and ordinary care of Lincoln Park, two thousand dollars.

For care and improvement of Monument grounds, three thousand dollars.

Old canal, etc.

Proviso.

Expenditure.

For continuing improvement of reservation numbered seventeen and site of old canal northwest of same, three thousand dollars: *Provided*, That no part thereof shall be expended upon other than property belonging to the United States.

For repair of post-and-chain fences, repair of high iron fences, and constructing stone coping about reservations, one thousand five hundred dollars.

For manure, and hauling the same, four thousand dollars.

For painting watchmen's lodges, iron fences, vases, lamps, and lamp-posts, one thousand dollars.

For purchase and repair of seats, one thousand dollars.

For purchase and repair of tools, two thousand dollars.

For trees, tree and plant stakes, labels, lime, whitewashing, and stock for nursery, to be purchased by contract or otherwise, as the Secretary of War may determine, two thousand dollars.

For removing snow and ice, one thousand two hundred dollars.

For flowerpots, twine, baskets, wire, splints, moss, and lycopodium, one thousand dollars.

For care, construction, and repair of fountains, one thousand five hundred dollars.

For abating nuisances, five hundred dollars.

For improvement, care, and maintenance of various reservations, ten thousand dollars.

For improvement, maintenance, and care of Smithsonian grounds, two thousand five hundred dollars.

For improvement, care, and maintenance of Judiciary Park, two thousand five hundred dollars.

Limit for concrete, etc., pavements.
Reduction.

That under appropriations herein contained no contract shall be made for making or repairing concrete or asphalt pavements in Washington City at a higher price than one dollar and eighty cents per square yard for a quality equal to the best laid in the District of Columbia prior to July first, eighteen hundred and eighty-six, and with a base of not less than six inches in thickness.

For laying asphalt walks in various reservations, two thousand dollars.

For cleaning statues and repairing pedestals, one hundred dollars.

Executive Mansion.
Repairs, fuel, etc.

EXECUTIVE MANSION: For care, repair, and refurnishing the Executive Mansion, twenty thousand dollars, to be expended by contract or otherwise, as the President may determine.

For fuel for the Executive Mansion, greenhouses, and stable, three thousand dollars.

For care and necessary repair of greenhouses, four thousand dollars.

For repairs to conservatory, Executive Mansion, two thousand dollars.

Lighting of Mansion and grounds.

Provisos.
Maximum per lamp.

To burn every night.

Self-regulating burners.

LIGHTING THE EXECUTIVE MANSION AND PUBLIC GROUNDS: For gas, pay of lamplighters, gas fitters, and laborers; purchase, erection, and repair of lamps and lamp-posts; purchase of matches, and repairs of all kinds; fuel and lights for office, office stable, watchmen's lodges, and for the greenhouses at the nursery, thirteen thousand dollars: *Provided*, That for each five-foot burner not connected with a meter in the lamps on the public grounds no more than twenty dollars shall be paid per lamp for gas, including lighting, cleaning, and keeping the lamps in repair, under any expenditure provided for in this Act; and said lamps shall burn every night on the average from forty-five minutes after sunset to forty-five minutes before sunrise; and authority is hereby given to substitute other illuminating material for the same or less price, and to use so much of the sum hereby appropriated as may be necessary for that purpose: *Provided*, That before any expenditures are made from the appropriations herein provided for, the contracting gas company shall equip each lamp with a self-regulating burner and tip, so combined and adjusted as to secure, under all ordinary variations of pressure and density, a consumption of five cubic feet of gas per hour.

Electric lights, etc.

Electric lights: For electric lights for three hundred and sixty-five nights from seven posts, at twenty cents per light per night, on grounds south of the Executive Mansion, five hundred and eleven dollars.

Parks.

Conduit system.

Proviso.

Connections with existing conduits, etc.

Pending litigation not affected, etc.

Conduits in Columbia Heights, etc.

Vol. 29, p. 401.

Overhead wires west of Rock Creek.

For lighting thirty-two arc electric lights in Lafayette, Franklin, Judiciary, and Lincoln parks three hundred and sixty-five nights, at twenty-five cents per light per night, which shall cover the entire cost to the United States of lighting and maintaining in good order each electric light in said parks, two thousand nine hundred and twenty dollars. Until Congress shall provide for a conduit system it shall be unlawful to lay conduits or erect overhead wires for electric lighting purposes in any road, street, avenue, highway, park, or reservation, except as hereafter specifically authorized by law: *Provided, however*, That the Commissioners of the District of Columbia are hereby authorized to issue permits for house connections with conduits and overhead wires now existing adjacent to the premises with which such connection is to be made; and also permits for public lighting connections with conduits already in the portion of the street proposed to be lighted. And nothing herein contained shall be construed to affect in any way any pending litigation involving the validity or invalidity or legality of the construction of any conduits made since June eighteenth, eighteen hundred and ninety-six, nor to prevent the United States Electric Lighting Company from extending conduits into Columbia Heights, Washington Heights, and Mount Pleasant within the fire limits as specifically provided in the Act of June eleventh, eighteen hundred and ninety-six, making appropriations for the expenses of the government of the District of Columbia; and the existing overhead wires of the Potomac Electric Power Company west of Rock Creek and outside the fire limits are hereby authorized to be maintained for a period of one year from the passage of this Act and no longer.

Water pipes, repairs, etc.

REPAIR OF WATER PIPES: For repairing and extending water pipes, purchase of apparatus for cleaning them, purchase of hose, and for cleaning the springs and repairing and renewing the pipes of the same that supply the Capitol, the Executive Mansion, and the building for the State, War, and Navy Departments, two thousand five hundred dollars.

Telegraph, Capitol, Departments, and Printing Office.

TELEGRAPH TO CONNECT THE CAPITOL WITH THE DEPARTMENTS AND GOVERNMENT PRINTING OFFICE: For care and repair of existing lines, one thousand five hundred dollars.

Washington Monument. Maintenance.

WASHINGTON MONUMENT: For the care and maintenance of the Washington Monument, namely: For one custodian, at one hundred dollars per month; one steam engineer, at eighty dollars per month; one assistant steam engineer, at sixty dollars per month; one fireman, at fifty dollars per month; one assistant fireman, at forty-five dollars per month; one conductor of elevator car, at seventy-five dollars per month; one attendant on floor, at sixty dollars per month; one attendant on top floor, at sixty dollars per month; three night and day watchmen, at sixty dollars per month each; in all, eight thousand five hundred and twenty dollars.

Expenses.

For fuel, lights, oil, waste, packing, tools, matches, paints, brushes, brooms, lanterns, rope, nails, screws, lead, electric lights, heating apparatus, oil stoves for elevator car and upper and lower floors, repairs to engines, boilers, dynamos, elevator, and repairs of all kinds connected with the monument and machinery, and purchase of all necessary articles for keeping the monument, machinery, elevator, and electric-light plant in good order, three thousand dollars.

* * * * *

Engineer Department.

ENGINEER DEPARTMENT.

River and harbor improvements.

Toward the construction of works on harbors and rivers under contracts or otherwise and within the limits authorized by law, namely:

Philadelphia, Pa.

For completing improvement of harbor at Philadelphia, Pennsylvania: Completing improvement, removal of Smiths Island and Windmill Island, Pennsylvania, and Petty Island, New Jersey, and adjacent shoals, six hundred and ninety-four thousand dollars.

Galveston, Tex.

For improving harbor at Galveston, Texas: Completing improvement, including repairs to jetties, and dredging, five hundred thousand dollars, of which amount ten thousand dollars may be expended for making a resurvey and chart for Galveston Bay and Harbor.

Hudson River, N. Y.

For improving Hudson River, New York: Continuing improvement, four hundred and seventy-five thousand dollars.

Great Lakes.

For completing improvement of channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo, including necessary observations and investigations in connection with the preservation of such channel depth, one million and ninety thousand dollars.

Point Judith, R. I.

For harbor of refuge at Point Judith, Rhode Island: Completing improvement, three hundred thousand dollars.

Humboldt, Cal.

For improving harbor and bay at Humboldt, California: Continuing improvement, three hundred and fifty thousand dollars.

Gowanus Bay, N. Y.

Improving channel in Gowanus Bay, New York: For improving Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels in the harbor of New York, New York: Continuing improvement, three hundred and fifty thousand dollars.

Savannah, Ga.

Improving harbor at Savannah, Georgia: For continuing improvement, three hundred and fifty thousand dollars.

Cumberland Sound, Ga. and Fla.

Improving Cumberland Sound, Georgia and Florida: For continuing improvement, three hundred and fifty thousand dollars.

Newtown Creek, N. Y.

Improving Newtown Creek, New York: For completing improvement, one hundred and eighty-three thousand dollars.

Portland, Me

Improving harbor at Portland, Maine: For continuing improvement, three hundred and fifty thousand dollars.

Rockland, Me.

Improving harbor at Rockland, Maine: For continuing improvement, three hundred and fifty thousand dollars.

Boston, Mass.

Improving harbor at Boston, Massachusetts: For continuing improvement, four hundred thousand dollars.

Buffalo, N. Y.

Improving harbor at Buffalo, New York: For continuing improvement, four hundred and eighty-one thousand two hundred and fifty dollars.

Dunkirk, N. Y.

Improving harbor at Dunkirk, New York: For completing improvement, three hundred and ninety-eight thousand two hundred and fifty-eight dollars.

Delaware Bay, Del.

Harbor of refuge, Delaware Bay, Delaware: For continuing construction, three hundred and ninety-four thousand three hundred and thirty-four dollars.

Winyah Bay, S. C.

Improving Winyah Bay, South Carolina: For continuing improvement of harbor at Winyah Bay, three hundred and fifty thousand dollars.

Sabine Pass, Tex.

Improving Sabine Pass, Texas: For continuing improvement of harbor at Sabine Pass, three hundred and fifty thousand dollars.

Cleveland, Ohio.

Improving harbor at Cleveland, Ohio: For continuing improvement, three hundred and fifty thousand dollars.

Maumee River and Bay.

The Secretary of War is hereby directed to cause to be made a survey and estimate of cost of deepening and widening the straight channel in Maumee River and Bay, with a view to obtaining and permanently securing a channel of a uniform width of four hundred feet and twenty feet deep at low water, the cost of said survey to be paid out of money already appropriated for the improvement of said channel.

Milwaukee Bay, Wis.

Harbor of refuge at Milwaukee Bay, Wisconsin: For completing improvement, one hundred and sixty-eight thousand seven hundred and thirty-seven dollars and ninety-one cents.

Duluth, Minn., Superior, Wis.

Improving harbor at Duluth, Minnesota, and Superior, Wisconsin: For continuing improvement, four hundred and thirty-seven thousand five hundred dollars.

Oakland, Cal.

Improving harbor at Oakland, California: For continuing improvement under present limit, two hundred thousand dollars. And the provision of the "Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," approved June third, eighteen hundred and ninety-six, relating to improving harbor at Oakland, California, is hereby amended to read as follows:

Vol. 29, p. 213.

Continuing harbor improvement.

Provisos. Contracts.

Limit.

Limit for fiscal year.

"Improving harbor at Oakland, California: Continuing improvement under existing project, twenty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to prosecute work on said improvement, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate six hundred and sixty-six thousand dollars: *Provided further*, That in making such contract or contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July first, eighteen hundred and ninety-seven, more than twenty-five per centum of the whole amount hereby authorized to be expended."

Board to locate deep-water harbor at Port Los Angeles, etc., allowance to member of.

Vol. 29, p. 213.

R. S., sec. 1566, p. 269.

The officer of the Coast and Geodetic Survey detailed to serve on the Board to locate a deep-water harbor for commerce and of refuge at Port Los Angeles, in Santa Monica Bay, California, or at San Pedro, in said State, which Board was created by an Act entitled "An Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," approved June third, eighteen hundred and ninety-six, United States Statutes at Large, page two hundred and thirteen, shall receive from the appropriation in said Act provided with relation to said harbor, in addition to his mileage provided for in section fifteen hundred and sixty-six of the Revised Statutes, and notwithstanding its provisions, such a per diem allowance for subsistence as the Secretary of War may deem proper.

Grays Harbor, Wash.

Improving Grays Harbor, Washington: For continuing improvement of harbor and bar entrance, three hundred and fifty thousand dollars.

Providence River and Narragansett Bay, R.I.

Improving Providence River and Narragansett Bay, Rhode Island: For continuing improvement, one hundred and twenty-five thousand dollars.

Allegheny River, Pa.

Locks and dams in Allegheny River, Pennsylvania: For continuing improvement by construction of locks and dams at Herr Island, above the head of Six-Mile Island, and at Springdale, three hundred and fifty thousand dollars.

Great Kanawha River, W. Va.

Improving the Great Kanawha River, West Virginia: Completing improvement, two hundred and seventy-three thousand dollars.

Monongahela River, W. Va.

Improving upper Monongahela River, West Virginia: For continuing improvement by the construction of six locks and dams, three hundred and fifty thousand dollars.

Ohio River.

Dams Nos. 2, 3, 4, and 5.

Vol. 29, p. 225, amended.

Improving the Ohio River: For continuing construction of Dams Numbered Two, Three, and Four, between Davis Island Dam and Dam Numbered Six, four hundred thousand dollars; and the provision in the river and harbor appropriation Act of June third, eighteen hundred and ninety-six, authorizing contracts to be made for improving Ohio River by the construction of Dams Numbered Two, Three, Four, and Five is hereby amended to read as follows:

Provisos.
Contracts.

Limit.

Limit for fiscal year.

"*Provided*, That contracts may be entered into by the Secretary of War for the whole or any part of the material and work as may be necessary to prosecute work on said improvement, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate one million nine hundred and ninety thousand dollars, exclusive of the amount herein appropriated: *Provided further*, That in making such contract or contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July first, eighteen hundred and ninety-seven, more than twenty-five per centum of the whole amount authorized to be expended."

Kentucky River, Ky.

Improving Kentucky River, Kentucky: For continuing the construction of Locks and Dams Numbered Seven and Eight, two hundred thousand dollars; and the provision of the "Act making appropriations for the construction, repair, Vol. 29, p. 324, amended.

Provisos. Contracts.

Limit.

Lock and dam No. 7.

Limit for fiscal year.

and preservation of certain public works on rivers and harbors, and for other purposes," approved June third, eighteen hundred and ninety-six, relating to improving Kentucky River, Kentucky, is hereby amended to read as follows: "*Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to prosecute work on said improvement in accordance with the present project for same, to be paid for as appropriations may from time to time be made by law, not exceeding in the aggregate one million three hundred and forty-nine thousand dollars, exclusive of the amount herein and heretofore appropriated: *Provided*, That of the amount authorized to be expended eighty-three thousand dollars, or so much thereof as may be necessary, may be expended in addition to the fifty thousand dollars herein appropriated in continuing construction and completion of Lock and Dam Numbered Seven, by contract or otherwise, and said eighty-three thousand dollars shall be immediately available: *Provided further*, That in making such contract or contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July first, eighteen hundred and ninety-seven, more than twenty-five per centum of the whole amount authorized to be expended."

Yazoo River, Miss.

Improving Yazoo River, Mississippi: For continuing improvement of mouth of Yazoo River and harbor of Vicksburg, three hundred and fifty thousand dollars.

Bayou Plaquemine, La.

Improving Bayou Plaquemine, Louisiana: For continuing improvement, three hundred and fifty thousand dollars.

Cumberland River, Tenn.

Improving Cumberland River above Nashville, Tennessee: For continuing improvement by construction of Locks Numbered Five, Six, and Seven, three hundred and fifty thousand dollars.

Ohio River Falls and Indiana Chute.

Proviso. Completion of improvement by contract or otherwise, etc.

Vol. 29, p. 324.

Improving Falls of Ohio River at Louisville, Kentucky: For continuing improvement, including Indiana Chute Falls, three hundred and fifty thousand dollars: *Provided*, That the Secretary of War may carry to completion the present project of improving the falls of the Ohio River and Indiana Chute Falls, Ohio River, by contract, as provided in the "Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," which became a law June third, eighteen hundred and ninety-six; or the necessary materials may be purchased and the work done otherwise than by contract, in his discretion, if more economical and advantageous to the United States.

Ohio River. Dam No. 6.

Locks and dams in Ohio River: For completing construction of Dam Numbered Six, at or below the mouth of Beaver River, three hundred thousand dollars.

Chicago River, Ill.

Vol. 29, p. 228.

Improving Chicago River, Illinois: For continuing improvement from its mouth to the stock yards on the South Branch, and to Belmont avenue on the North Branch, one hundred and thirteen thousand dollars, in pursuance of the provisions of "An Act making appropriations for the construction, repair, and improvement of certain public works

Intent.

Proviso.
Total cost.

on rivers and harbors, and for other purposes," approved June third, eighteen hundred and ninety-six; and it is hereby declared to be the true intent and meaning of the said provisions of said Act relating to the improvement of said Chicago River that all of the work in the improvement of said river which was recommended or suggested to be done in the interest of commerce by Captain William L. Marshall, of the Corps of Engineers of the United States Army, in his report of August ninth, eighteen hundred and ninety-three, may be done: *Provided*, That the total cost of such improvement or work shall not exceed the limit provided for in said Act.

Illinois and Mississippi Canal.

Illinois and Mississippi Canal: For continuing construction, eight hundred and seventy-five thousand dollars.

Waterway, Keweenaw Bay to Lake Superior.

Improving waterway from Keweenaw Bay to Lake Superior, Michigan: For continuing improvement of water communication across Keweenaw Point, three hundred and fifty thousand dollars.

Mississippi River.
Mouth of Ohio River to St. Paul.

Improving Mississippi River from the mouth of the Ohio River to Saint Paul, Minnesota: For continuing improvement from the mouth of the Ohio River to the mouth of the Missouri River, six hundred and seventy-three thousand three hundred and thirty-three dollars and thirty-three cents.

Mouth of Missouri River to St. Paul.

Provisos.
Removal of sand bars at Dubuque and Muscatine, Iowa.

Artificial banks from mouth of Flint to mouth of Iowa Rivers.

For continuing improvement from the mouth of the Missouri River to Saint Paul, eight hundred and twenty-six thousand six hundred and sixty-six dollars and sixty-seven cents: *Provided*, That thirty thousand dollars of said sum, or as much thereof as may be necessary, shall be expended in removing the sand bar which obstructs the channel of the Mississippi River in front of Dubuque, Iowa, and the entrance to the harbor of refuge at Dubuque, Iowa, and that fifteen thousand dollars, or so much thereof as may be necessary, shall be expended in removing the sand bar which obstructs the channel of the Mississippi River in front of Muscatine, Iowa: *Provided further*, That the sum of fifty thousand dollars of said sum shall be expended for continuing the work of constructing artificial banks between the mouth of Flint River and running along the west bank of the Mississippi River to the mouth of the Iowa River.

Willamette and Yamhill rivers, Oregon.

Improving Willamette and Yamhill rivers, Oregon: For completing mprovement, one hundred and sixty thousand dollars.

Mississippi River Commission.
Head of Passes to the Ohio.
Expenses, etc.

Improving Mississippi River: For continuing improvement of Mississippi River from Head of the Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission, two million nine hundred and thirty-three thousand three hundred and thirty-three dollars; which sum, in the discretion of the Secretary of War, may be immediately available for expenditure under contract or otherwise. And of the sum hereby appropriated, six hundred thousand dollars shall be deducted from the sum of two million five hundred and thirty-three thousand three hundred and thirty-three dollars authorized to be appropriated and expended for the fiscal year ending June thirtieth, eighteen hundred and ninety-nine, by the "Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," which became a law on June third, eighteen hundred and ninety-six. Vol. 29, p. 230.

Prevention of break into Cache River, etc.

For the purpose of preventing the Mississippi River from breaking through into the Cache River at or near a point known as Beach Ridge, a few miles north of Cairo, whereby the National Cemetery at Mound City, at the mouth of the Cache River, and the Marine Hospital at Cairo would be in imminent danger of destruction, the sum of one hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated, to be immediately available.

Missouri River Commission. Expenses, etc.

Improving Missouri River from mouth to Sioux City, Iowa: For continuing improvement of Missouri River from its mouth to Sioux City, Iowa, including salaries, clerical, office, traveling, and miscellaneous expenses of the Missouri River Commission, surveys, permanent bench marks, and gauges, three hundred thousand dollars; of the sum heretofore appropriated for improving the Missouri River, the Secretary of War is directed to expend not exceeding twenty-five thousand dollars to repair and protect the works in the neighborhood of Nebraska City, in the State of Nebraska. Nebraska City, Nebr.

Suwanee River, Fla.

The unexpended balance of the appropriation for the improvement of the Suwanee River, Florida, may, in the discretion of the Secretary of War, be expended for deepening the West Pass of the Suwanee River at its mouth.

Gull Lake, Minn.

A sum not exceeding fifteen thousand dollars, or so much thereof as may be necessary, of the money heretofore appropriated for the construction of reservoirs at the head waters of the Mississippi River may be used and is hereby made available for the payment of damages for lands and tenements overflowed or injured by the construction of a reservoir and dam at Gull Lake, Minnesota.

The water hyacinth, investigation of, etc.

That the Secretary of War be, and he is hereby, authorized to investigate the extent of the obstruction of the navigable waters of Florida, Louisiana, and other South Atlantic and Gulf States by the aquatic plant known as the water hyacinth, and to perform such experimental work as he shall deem necessary to determine some suitable and feasible plan or method of checking and removing such obstacle, so far as it is a hindrance to interstate or foreign commerce, and to report the results of such investigation and experimental work; and the sum of five thousand dollars, or so much thereof as may be necessary, is hereby appropriated to pay the cost thereof.

Waterway from Warrior River to Five Mile Creek, etc.

That the Secretary of War be, and he hereby is, directed to cause a survey to be made to examine into the feasibility and advisability of the improvement of the waterway beginning at a point at or near the site selected for Lock Numbered Thirteen, on the Warrior River, and continuing up Valley River from its mouth, following the general course of said stream, to Bessemer, Alabama; thence up the Valley to Birmingham and beyond to Five Mile Creek, at a point where sufficient head can be obtained to supply water for that part of said route between Five Mile Creek and Bessemer, Alabama, so as to secure a channel to have a minimum depth of six feet and be at least fifty feet in width at the water line, and to ascertain the cost of such improvement, and the cost of such survey shall be defrayed from the unexpended balance of the funds heretofore appropriated for the improvement of the Black Warrior River from Tuscaloosa to Daniels Creek.

Sabine Pass, Tex. Dredge boat, etc.

For the purchase of a dredge boat for use in the harbor improvement at Sabine Pass, Texas, one hundred thousand dollars, and for the expense of operating the same during the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, thirty thousand dollars; in all, one hundred and thirty thousand dollars.

* * * * *

Mobile Bay, Ala.

For maintaining and keeping open the channel in Mobile Bay, in the State of Alabama, twenty-five thousand dollars, or so much thereof as may be necessary, to be expended under the direction of the Secretary of War during the fiscal year ending June thirtieth, eighteen hundred and ninety-eight.

Estimates, etc.

And hereafter the Secretary of War shall annually submit estimates in detail for river and harbor improvements required for the ensuing fiscal year to the Secretary of the Treasury to be included in, and carried into the sum total of, the Book of Estimates.

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Miscellaneous.

MISCELLANEOUS OBJECTS, WAR DEPARTMENT.

Survey of northern, etc., lakes.

SURVEY OF NORTHERN AND NORTHWESTERN LAKES: For printing and issuing charts for use of navigators and electrotyping plates for chart printing, two thousand dollars.

For surveys, additions to, and correcting engraved plates, to be available until expended, twenty-five thousand dollars.

Transporting maps.

TRANSPORTATION OF REPORTS AND MAPS TO FOREIGN COUNTRIES: For the transportation of reports and maps to foreign countries through the Smithsonian Institution, one hundred dollars.

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California Débris Commission. Expenses. Vol. 27, p. 507.

CALIFORNIA DÉBRIS COMMISSION: For defraying the expenses of the Commission in carrying on the work authorized by the Act of Congress approved March first, eighteen hundred and ninety-three, fifteen thousand dollars.

New York Harbor.

HARBOR OF NEW YORK: For prevention of obstructive and injurious deposits within the harbor and adjacent waters of New York City:

Inspectors, etc.

For pay of inspectors and deputy inspectors, office force, and expenses of office, ten thousand two hundred and sixty dollars;

For pay of crews and maintenance of four steam tugs and three launches, forty-eight thousand seven hundred and forty dollars; Vessels.

In all, fifty-nine thousand dollars.

* * * * *

DEEP WATERWAYS COMMISSION: For surveys and examinations (including estimate of cost) of deep waterways and the routes thereof, between the Great Lakes and the Atlantic tide waters, as recommended by the report of the Deep Waterways Commission transmitted by the President to Congress January eighteenth, eighteen hundred and ninety-seven, one hundred and fifty thousand dollars. Deep waterways between Great Lakes and Atlantic tide waters. Such examinations and surveys shall be made by a board of three engineers, to be designated by the President, one of whom may be detailed from the Engineer Corps of the Army, one from the Coast and Geodetic Survey, and one shall be appointed from civil life. Board to survey, etc.

That for the purpose of ascertaining the character and value of the improvements made at the Pass of Aransas, on the Gulf coast of Texas, by the Aransas Pass Harbor Company, a board of three engineers shall be appointed by the President, from the Engineer Corps of the Army; and such board shall personally make examination of the work done by said company for the purpose of deepening the channel and removing the bar at or near said Pass of Aransas. Pass of Aransas, Texas. Board to examine improvements.

It shall be the duty of the board so constituted to report the depth of water upon the bar at the time of their examination; the character of the work done and the cost of same; the character and cost of any unfinished work contracted to be done by said company; the probable result upon the deepening of the channel across the bar of any work contracted for or contemplated by said company, but not then finished; the value to the Government of all work done or contracted to be done by said company for the purpose of deepening said channel or removing said bar, and such other information as they may deem essential to be known to Congress in making future provision for the purchase of said works by the United States Government. Duties.

Said board shall report the result of their investigation to the Secretary of War on or before the first Monday in December, eighteen hundred and ninety-seven, and the Secretary shall immediately transmit the report to Congress; and five thousand dollars, or so much thereof as may be necessary, is hereby appropriated to pay the expenses of the said board and for the services of the said engineers, the amount of such compensation for said services to be fixed by the Secretary of War. Report.

MEMORIAL BRIDGE ACROSS POTOMAC RIVER: To enable the Chief of Engineers of the Army to make the necessary surveys, soundings, and borings, and for securing designs and estimates for a memorial bridge from the most convenient point of the Naval Observatory grounds, or adjacent thereto, across the Potomac River to the most Memorial bridge, Potomac River.

convenient point of the Arlington estate property, two thousand five hundred dollars.

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State Department.

UNDER THE STATE DEPARTMENT.

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Nicaragua Canal.
Commission to continue surveys, etc.
Vol 28, p. 948.

NICARAGUA CANAL COMMISSION: To continue the surveys and examinations authorized by the Act approved March second, eighteen hundred and ninety-five, entitled "An Act making appropriations for the sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, and for other purposes," into the proper route, the feasibility and cost of construction of the Nicaragua Canal, with the view of making complete plans for the entire work of construction of such canal as therein provided, one hundred and fifty thousand dollars; and to carry out this purpose the President of the United States is authorized to appoint, by and with the advice and consent of the Senate, a commission to consist of one engineer from the Corps of Engineers of the United States Army, one officer of the Navy, who may be taken from the active or retired lists, and one engineer from civil life, said commission to have all the powers and duties conferred upon the commission provided for in said Act.

* * * * *

Approved, June 4, 1897.

June 7, 1897.

CHAP. 4.—An Act To adopt regulations for preventing collisions upon certain harbors, rivers, and inland waters of the United States.

Navigation.
Vol. 26, p. 320.
Vol. 28, pp. 82, 281.
Vol. 29, p. 381.

Whereas the provisions of chapter eight hundred and two of the laws of eighteen hundred and ninety, and the amendments thereto, adopting regulations for preventing collisions at sea, apply to all waters of the United States connected with the high seas navigable by seagoing vessels, except so far as the navigation of any harbor, river, or inland waters is regulated by special rules duly made by local authority; and

Inland waters.

Whereas it is desirable that the regulations relating to the navigation of all harbors, rivers, and inland waters of the United States, except the Great Lakes and their connecting and tributary waters as far east as Montreal and the Red River of the North and rivers emptying into the Gulf of Mexico and their tributaries, shall be stated in one Act: Therefore,

Regulations to prevent collisions.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following regulations for preventing collision shall be followed by all vessels navigating all harbors, rivers, and inland waters of the United States, except the Great Lakes and their connecting and tributary waters as far east as Montreal and the Red River of the North and rivers emptying into the Gulf of Mexico and their tributaries, and are hereby declared special rules duly made by local authority:

[To be inserted at page 4208 Annual Report of the Chief of Engineers, 1897.]

CHAP. 3.—An Act Making appropriations for the current and contingent expenses of the Indian Department and for fulfilling treaty stipulations with various Indian tribes for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, and for other purposes.

June 7, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and they are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the purpose of paying the current and contingent expenses of the Indian Department in full compensation for all offices the salaries for which are specially provided for herein for the service of the fiscal year ending June thirtieth, eighteen hundred and ninety-eight, and fulfilling treaty stipulations for the various Indian tribes, namely:

Indian Department appropriations.

* * * * *

Surveys.

For completing the necessary surveys within the Chippewa Indian Reservation in Minnesota, including expenses of examining and appraising pine lands, under the provisions of the Act approved January fourteenth, eighteen hundred and eighty-nine, to be reimbursed to the United States out of proceeds of the sale of their lands, fifty thousand dollars: *Provided*, That all lands acquired and sold by the United States under the "Act for the relief and civilization of the Chippewa Indians in the State of Minnesota," approved January fourteenth, eighteen hundred and eighty-nine, shall be subject to the right of the United States to construct and maintain dams for the purpose of creating reservoirs in aid of navigation, and no claim or right of compensation shall accrue from the overflowing of said lands on account of the construction and maintenance of such dams or reservoirs. And the Secretary of War shall furnish the Commissioner of the General Land Office a list of such lands, with the particular tracts appropriately described, and in the disposal of each and every one of said tracts, whether by sale, by allotment in severalty to individual Indians, or otherwise, under said Act, the provisions of this paragraph shall enter into and form a part of the contract of purchase or transfer of title.

Proviso.
Aids to navigation.

U. S. not liable for overflows.

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Approved, June 7, 1897.

PRELIMINARY.

In the following rules every steam-vessel which is under sail and not under steam is to be considered a sailing-vessel, and every vessel, under steam, whether under sail or not, is to be considered a steam vessel.

Meaning of terms.
Sailing vessel.
Steam vessel.

The word "steam-vessel" shall include any vessel propelled by machinery.

A vessel is "under way," within the meaning of these rules, when she is not at anchor, or made fast to the shore, or aground.

"Under way."

RULES CONCERNING LIGHTS, AND SO FORTH.

Rules concerning lights, etc.

The word "visible" in these rules, when applied to lights, shall mean visible on a dark night with a clear atmosphere.

Meaning of "visible."

ARTICLE 1. The rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

Period of compliance.

ART. 2. A steam-vessel when under way shall carry—

(a) On or in front of the foremast, or, if a vessel without a foremast, then in the fore part of the vessel, a bright white light so constructed as to show an unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the vessel, namely, from right ahead to two points abaft the beam on either side, and of such a character as to be visible at a distance of at least five miles.

Steam vessels under way, white light forward.

Visibility.

(b) On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least two miles.

Green light, starboard side.

(c) On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side, and of such a character as to be visible at a distance of at least two miles.

Red light, port side.

Visibility.

(d) The said green and red side-lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

Inboard screens for green and red lights.

(e) A sea-going steam-vessel when under way may carry an additional white light similar in construction to the light mentioned in subdivision (a). These two lights shall be so placed in line with the keel that one shall be at least fifteen feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance. (f) All steam-vessels (except sea-going vessels and ferry-boats), shall carry in addition to green and red lights required by article two (b), (c), and screens as required by article two (d), a

Additional white light.

Position, etc., of two white lights.

Central range of two white lights.

central range of two white lights; the after-light being carried at an elevation at least fifteen feet above the light at the head of the vessel. The head-light shall be so constructed as to show an unbroken light through twenty points of the compass, namely, from right ahead to two points abaft the beam on either side of the vessel, and the after-light so as to show all around the horizon.

Steam vessel towing another vessel. Lights. When towing more than one. Additional light. Character and position of lights.

ART. 3. A steam-vessel when towing another vessel shall, in addition to her side-lights, carry two bright white lights in a vertical line one over the other, not less than three feet apart, and when towing more than one vessel shall carry an additional bright white light three feet above or below such lights, if the length of the tow measuring from the stern of the towing vessel to the stern of the last vessel towed exceeds six hundred feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the white light mentioned in article two (a) or the after range light mentioned in article two (f).

Small white light abaft. Visibility restricted.

Such steam vessel may carry a small white light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

Sailing vessel under way or being towed. Lights.

ART. 5. A sailing-vessel under way or being towed shall carry the same lights as are prescribed by article two for a steam-vessel under way, with the exception of the white lights mentioned therein, which they shall never carry.

Small vessels under way in bad weather. Exhibition of portable lights.

ART. 6. Whenever, as in the case of vessels of less than ten gross tons under way during bad weather, the green and red side-lights can not be fixed, these lights shall be kept at hand, lighted and ready for use; and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side, nor, if practicable, more than two points abaft the beam on their respective sides. To make the use of these portable lights more certain and easy the lanterns containing them shall each be painted outside with the color of the light they respectively contain, and shall be provided with proper screens.

Rowing boats. Lantern.

ART. 7. Rowing boats, whether under oars or sail, shall have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision.

Pilot-vessels on pilotage duty.

ART. 8. Pilot-vessels when engaged on their station on pilotage duty shall not show the lights required for other vessels, but shall carry a white light at the masthead, visible all around the horizon, and shall also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed fifteen minutes.

Approach of or to other vessels.

On the near approach of or to other vessels they shall have their side-lights lighted, ready for use, and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side nor the red light on the starboard side.

A pilot-vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board may show the white light instead of carrying it at the masthead, and may, instead of the colored lights above mentioned, have at hand, ready for use, a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above.

Such as go alongside of a vessel, etc.

Pilot-vessels, when not engaged on their station on pilotage duty, shall carry lights similar to those of other vessels of their tonnage.

Pilot-vessels not on pilotage duty.

ART. 9. (a) Fishing-vessels of less than ten gross tons, when under way and when not having their nets, trawls, dredges, or lines in the water, shall not be obliged to carry the colored side-lights; but every such vessel shall, in lieu thereof, have ready at hand a lantern with a green glass on one side and a red glass on the other side, and on approaching to or being approached by another vessel such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

Fishing vessels of less than ten gross tons, under way, etc., lantern.

(b) All fishing-vessels and fishing-boats of ten gross tons or upward, when under way and when not having their nets, trawls, dredges, or lines in the water, shall carry and show the same lights as other vessels under way.

Of ten gross tons or upward.

(c) All vessels, when trawling, dredging, or fishing with any kind of drag-nets or lines, shall exhibit, from some part of the vessel where they can be best seen, two lights. One of these lights shall be red and the other shall be white. The red light shall be above the white light, and shall be at a vertical distance from it of not less than six feet and not more than twelve feet; and the horizontal distance between them, if any, shall not be more than ten feet. These two lights shall be of such a character and contained in lanterns of such construction as to be visible all round the horizon, the white light a distance of not less than three miles and the red light of not less than two miles.

Vessel when trawling, etc.

(d) Rafts, or other water craft not herein provided for, navigating by hand power, horse power, or by the current of the river, shall carry one or more good white lights, which shall be placed in such manner as shall be prescribed by the Board of Supervising Inspectors of Steam Vessels.

Rafts or other craft, etc.

ART. 10. A vessel which is being overtaken by another, except a steam-vessel with an after range-light showing all around the horizon, shall show from her stern to such last-mentioned vessel a white light or a flare-up light.

Vessels being overtaken by another.

ART. 11. A vessel under one hundred and fifty feet in length when at anchor shall carry forward, where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light, in a lantern so constructed as to show a clear, uniform, and unbroken light visible all around the horizon at a distance of at least one mile.

Vessels under one hundred and fifty feet in length, at anchor.

A vessel of one hundred and fifty feet or upwards in length when at anchor shall carry in the forward part of the vessel, at a height of not less than twenty and not exceeding forty feet above the hull, one such light, and at or near the stern of the vessel, and at such a height that it

One hundred and fifty feet or upward in length.

shall be not less than fifteen feet lower than the forward light, another such light.

Length governed by registry.

The length of a vessel shall be deemed to be the length appearing in her certificate of registry.

Additional lights, etc., when necessary.

ART. 12. Every vessel may, if necessary, in order to attract attention, in addition to the lights which she is by these rules required to carry, show a flare up light or use any detonating signal that can not be mistaken for a distress signal.

Ships of war and convoys.
Special rules respecting additional lights, etc., not interfered with, etc.

ART. 13. Nothing in these rules shall interfere with the operation of any special rules made by the Government of any nation with respect to additional station and signal lights for two or more ships of war or for vessels sailing under convoy, or with the exhibition of recognition signals adopted by shipowners, which have been authorized by their respective Governments, and duly registered and published.

Steam vessels under sail only.
Day signal.

ART. 14. A steam-vessel proceeding under sail only, but having her funnel up, may carry in daytime, forward, where it can best be seen, one black ball or shape two feet in diameter.

Sound signals for fog, etc.

SOUND SIGNALS FOR FOG, AND SO FORTH.

ART. 15. All signals prescribed by this article for vessels under way shall be given:

"Steam vessels."

1. By "steam-vessels" on the whistle or siren.

"Sailing vessels," etc.

2. By "sailing-vessels" and "vessels towed" on the fog horn.

Meaning of "prolonged blasts."

The words "prolonged blast" used in this article shall mean a blast of from four to six seconds duration.

Sound instruments to be provided steam vessels.

A steam-vessel shall be provided with an efficient whistle or siren, sounded by steam or by some substitute for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient fog horn; also with an efficient bell. A sailing-vessel of twenty tons gross tonnage or upward shall be provided with a similar fog horn and bell.

Signals in fog, mist, etc.

In fog, mist, falling snow, or heavy rainstorms, whether by day or night, the signals described in this article shall be used as follows, namely:

Steam vessel under way.

(a) A steam-vessel under way shall sound, at intervals of not more than one minute, a prolonged blast.

Sailing vessel under way.

(c) A sailing-vessel under way shall sound, at intervals of not more than one minute, when on the starboard tack, one blast; when on the port tack, two blasts in succession, and when with the wind abaft the beam, three blasts in succession.

Vessel at anchor.

(d) A vessel when at anchor shall, at intervals, of not more than one minute, ring the bell rapidly for about five seconds.

Steam vessel towing.
Vessel towed.

(e) A steam-vessel when towing, shall, instead of the signals prescribed in subdivision (a) of this article, at intervals of not more than one minute, sound three blasts in succession, namely, one prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other.

(f) All rafts or other water craft, not herein provided for, navigating by hand power, horse power, or by the current of the river, shall sound a blast of the fog-horn, or equivalent signal, at intervals of not more than one minute.

Rafts or other water craft.

SPEED OF SHIPS TO BE MODERATE IN FOG, AND SO FORTH.

Speed of ships in fog, etc.

ART. 16. Every vessel shall, in a fog, mist, falling snow, or heavy rainstorms, go at a moderate speed, having careful regard to the existing circumstances and conditions.

To be moderate.

A steam-vessel hearing, apparently forward of her beam, the fog-signal of a vessel the position of which is not ascertained shall, so far as the circumstances of the case admit, stop her engines, and then navigate with caution until danger of collision is over.

Stoppage of engines on certain conditions, etc.

STEERING AND SAILING RULES.

Steering and sailing rules.

PRELIMINARY—RISK OF COLLISION.

Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change, such risk should be deemed to exist.

Ascertainment of risk of collision.

ART. 17. When two sailing-vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows, namely:

Two sailing vessels approaching one another; rules of avoidance of collision.

(a) A vessel which is running free shall keep out of the way of a vessel which is close-hauled.

(b) A vessel which is close-hauled on the port tack shall keep out of the way of a vessel which is closed-hauled on the starboard tack.

(c) When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other.

(d) When both are running free, with the wind on the same side, the vessel which is to the windward shall keep out of the way of the vessel which is to the leeward.

(e) A vessel which has the wind aft shall keep out of the way of the other vessel.

ART. 18. RULE I. When steam-vessels are approaching each other head and head, that is, end on, or nearly so, it shall be the duty of each to pass on the port side of the other; and either vessel shall give, as a signal of her intention, one short and distinct blast of her whistle, which the other vessel shall answer promptly by a similar blast of her whistle, and thereupon such vessels shall pass on the port side of each other. But if the courses of such vessels are so far on the starboard of each other as not to be considered as meeting head and head, either vessel shall immediately give two short and distinct blasts of her whistle, which the other vessel shall answer promptly by two similar blasts of her whistle, and they shall pass on the starboard side of each other.

Steam vessels approaching each other end on.

The foregoing only applies to cases where vessels are meeting end on or nearly end on, in such a manner as to

Applicable cases.

involve risk of collision; in other words, to cases in which, by day, each vessel sees the masts of the other in a line, or nearly in a line, with her own, and by night to cases in which each vessel is in such a position as to see both the side-lights of the other.

Inapplicable cases.

It does not apply by day to cases in which a vessel sees another ahead crossing her own course, or by night to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where a red light without a green light or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

Failing to understand the course, etc., of the other.

RULE III. If, when steam-vessels are approaching each other, either vessel fails to understand the course or intention of the other, from any cause, the vessel so in doubt shall immediately signify the same by giving several short and rapid blasts, not less than four, of the steam-whistle.

Steam vessel nearing short bend or curve in the channel, etc.

RULE V. Whenever a steam-vessel is nearing a short bend or curve in the channel, where, from the height of the banks or other cause, a steam-vessel approaching from the opposite direction can not be seen for a distance of half a mile, such steam-vessel, when she shall have arrived within half a mile of such curve or bend, shall give a signal by one long blast of the steam-whistle, which signal shall be answered by a similar blast, given by any approaching steam-vessel that may be within hearing. Should such signal be so answered by a steam-vessel upon the farther side of such bend, then the usual signals for meeting and passing shall immediately be given and answered; but, if the first alarm signal of such vessels be not answered, she is to consider the channel clear and govern herself accordingly.

Steam vessels moved from their docks, etc.

When steam-vessels are moved from their docks or berths, and other boats are liable to pass from any direction toward them, they shall give the same signal as in the case of vessels meeting at a bend, but immediately after clearing the berths so as to be fully in sight they shall be governed by the steering and sailing rules.

One steam vessel desiring to pass another going in the same direction.

RULE VIII. When steam-vessels are running in the same direction, and the vessel which is astern shall desire to pass on the right or starboard hand of the vessel ahead, she shall give one short blast of the steam-whistle, as a signal of such desire, and if the vessel ahead answers with one blast, she shall put her helm to port; or if she shall desire to pass on the left or port side of the vessel ahead, she shall give two short blasts of the steam-whistle as a signal of such desire, and if the vessel ahead answers with two blasts, shall put her helm to starboard; or if the vessel ahead does not think it safe for the vessel astern to attempt to pass at that point, she shall immediately signify the same by giving several short and rapid blasts of the steam-whistle, not less than four, and under no circumstances shall the vessel astern attempt to pass the vessel ahead until such time as they have reached a point where it can be safely done, when said vessel ahead shall signify her willingness by blowing the proper signals. The vessel ahead shall in no case attempt to cross the bow or crowd upon the course of the passing vessel.

Whistle signals only for steamers in sight of each other; otherwise fog signals.

RULE IX. The whistle signals provided in the rules under this article, for steam-vessels meeting, passing, or overtaking, are never to be used except when steamers are in sight of each other, and the course and position of each can be determined in the daytime by a sight of the vessel itself, or by night by seeing its signal lights. In fog, mist, falling snow or heavy rainstorms, when vessels can not so see each other, fog-signals only must be given.

Two steam vessels crossing.

ART. 19. When two steam-vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

Where risk of collision, steam to avoid sailing vessels.

ART. 20. When a steam-vessel and a sailing-vessel are proceeding in such directions as to involve risk of collision, the steam-vessel shall keep out of the way of the sailing-vessel.

What vessel shall keep her course, etc.

ART. 21. Where, by any of these rules, one of the two vessels is to keep out of the way, the other shall keep her course and speed.

Crossing ahead.

ART. 22. Every vessel which is directed by these rules to keep out of the way of another vessel shall, if the circumstances of the case admit, avoid crossing ahead of the other.

Certain vessels to slacken speed, etc.

ART. 23. Every steam-vessel which is directed by these rules to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop or reverse.

Vessels overtaking another vessel, etc.

ART. 24. Notwithstanding anything contained in these rules every vessel, overtaking any other, shall keep out of the way of the overtaken vessel.

Definition of "overtaking vessel."

Every vessel coming up with another vessel from any direction more than two points abaft her beam, that is, in such a position, with reference to the vessel which she is overtaking that at night she would be unable to see either of that vessel's side-lights, shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

By day.

As by day the overtaking vessel can not always know with certainty whether she is forward of or abaft this direction from the other vessel she should, if in doubt, assume that she is an overtaking vessel and keep out of the way.

Steam vessel in narrow channel.

ART. 25. In narrow channels every steam-vessel shall, when it is safe and practicable, keep to that side of the fair-way or mid-channel which lies on the starboard side of such vessel.

Sailing vessels under way to avoid vessels fishing, etc.

ART. 26. Sailing-vessels under way shall keep out of the way of sailing-vessels or boats fishing with nets, or lines, or trawls. This rule shall not give to any vessel or boat engaged in fishing the right of obstructing a fair-way used by vessels other than fishing-vessels or boats.

Departure from rules because of exigency.

ART. 27. In obeying and construing these rules due regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

Sound signals for vessels in sight of one another.

SOUND SIGNALS FOR VESSELS IN SIGHT OF ONE ANOTHER.

ART. 28. When vessels are in sight of one another a steam-vessel under way whose engines are going at full speed astern shall indicate that fact by three short blasts on the whistle.

No vessel under any circumstances to neglect proper precautions.

NO VESSEL UNDER ANY CIRCUMSTANCES TO NEGLECT PROPER PRECAUTIONS.

ART. 29. Nothing in these rules shall exonerate any vessel, or the owner or master or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

Lights on war or revenue vessels, temporary discontinuance of.

ART. 30. The exhibition of any light on board of a vessel of war of the United States or a revenue cutter may be suspended whenever, in the opinion of the Secretary of the Navy, the commander in chief of a squadron, or the commander of a vessel acting singly, the special character of the service may require it.

Distress signals.

DISTRESS SIGNALS.

ART. 31. When a vessel is in distress and requires assistance from other vessels or from the shore the following shall be the signals to be used or displayed by her, either together or separately, namely:

In the daytime.

IN THE DAYTIME.

A continuous sounding with any fog-signal apparatus, or firing a gun.

At night.

AT NIGHT.

First. Flames on the vessel as from a burning tar barrel, oil barrel, and so forth.

Second. A continuous sounding with any fog-signal apparatus, or firing a gun.

Rules to be established as to lights, etc.

SEC. 2. That the supervising inspectors of steam-vessels and the Supervising Inspector-General shall establish such rules to be observed by steam vessels in passing each other and as to the lights to be carried by ferry-boats and by barges and canal-boats when in tow of steam-vessels, not inconsistent with the provisions of this Act, as they from time to time may deem necessary for safety, which rules when approved by the Secretary of the Treasury, are hereby declared special rules duly made by local authority, as provided for in article thirty of chapter eight hundred and two

Declared special rules, etc.
Vol. 26, p. 328.

of the laws of eighteen hundred and ninety. Two printed copies of such rules shall be furnished to such ferry-boats and steam-vessels, which rules shall be kept posted up in conspicuous places in such vessels.

Printed copies for ferryboats, etc.

SEC. 3. That every pilot, engineer, mate, or master of any steam-vessel, and every master or mate of any barge or canal-boat, who neglects or refuses to observe the provisions of this Act, or the regulations established in pursuance of the preceding section, shall be liable to a penalty of fifty dollars, and for all damages sustained by any passenger in his person or baggage by such neglect or refusal: *Provided*, That nothing herein shall relieve any vessel, owner or corporation from any liability incurred by reason of such neglect or refusal.

Penalty for pilots, etc.

Proviso.
Liability of vessel, owner, etc., unchanged.

SEC. 4. That every vessel that shall be navigated without complying with the provisions of this Act shall be liable to a penalty of two hundred dollars, one-half to go to the informer, for which sum the vessel so navigated shall be liable and may be seized and proceeded against by action in any district court of the United States having jurisdiction of the offense.

Penalty for vessels.

SEC. 5. That sections forty-two hundred and thirty-three and forty-four hundred and twelve (with the regulations made in pursuance thereof, except the rules and regulations for the government of pilots of steamers navigating the Red River of the North and rivers emptying into the Gulf of Mexico and their tributaries, and except the rules for the Great Lakes and their connecting and tributary waters as far east as Montreal), and forty-four hundred and thirteen of the Revised Statutes of the United States, and chapter two hundred and two of the laws of eighteen hundred and ninety-three, and sections one and three of chapter one hundred and two of the laws of eighteen hundred and ninety-five, and sections five, twelve, and thirteen of the Act approved March third, eighteen hundred and ninety-seven, entitled "An Act to amend the laws relating to navigation," and all amendments thereto, are hereby repealed so far as the harbors, rivers, and inland waters aforesaid (except the Great Lakes and their connecting and tributary waters as far east as Montreal and the Red River of the North and rivers emptying into the Gulf of Mexico, and their tributaries) are concerned.

Repeal of rules and regulations.
R. S., secs. 4233, 4412, pp. 815, 854.

R. S., sec. 4413, p. 854.
Vol. 27, p. 557.

Vol. 28, p. 672.

Vol. 29, pp. 689, 690.

SEC. 6. That this Act shall take effect four months from the date of its approval.

When to take effect.

Approved, June 7, 1897.

CHAP. 5.—An Act To authorize the construction of a bridge across the Clinch River, Kingston, Tennessee.

June 9, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the county of Roane, in the State of Tennessee, in its corporate capacity, is hereby authorized and empowered to construct and maintain a bridge over and across the Clinch River at or near the town of Kingston, so as to connect

Roane County Tenn., may bridge Clinch River at Kingston, etc.

said town of Kingston with the opposite or north bank of said river.

Aids to navigation.
Draw.
Lights.

SEC. 2. That said bridge shall be so constructed that a reasonable free and unobstructed passageway may be secured to all water craft navigating said river at the point aforesaid; and if said bridge shall be constructed as a drawbridge, the draw shall be opened promptly, upon reasonable signal, for the passage of boats and vessels; and whatever kind of bridge is constructed, the owners thereof shall maintain, at their own expense, from sunset to sunrise, such lights or other signals thereon as the Light-House Board shall prescribe.

Secretary of War to approve plans.
Changes.

SEC. 3. That said bridge shall not be built or commenced until the plans and location of the same shall have been approved by the Secretary of War; and no change shall be made in this construction, and no alteration of it shall be made after its construction, unless such change or alteration shall in like manner receive the approval of the Secretary of War.

Notification of approval.

SEC. 4. That the Secretary of War, upon receiving the design, drawings, and specifications of said bridge, and a map of the location, and such other information as he may call for, and upon being satisfied that the bridge, when built according to such designs and drawings, will be in accordance with the requirements of this Act, and will not unreasonably obstruct the navigation of said river, be, and is hereby, authorized and directed to approve said design, drawings, and specifications, and to so notify said county of Roane. Upon receiving such notification the said county of Roane may proceed to construct said bridge, conforming strictly to the approved design, drawings, and specifications.

Lawful structure and post route.

SEC. 5. That any bridge built under this Act, according to its limitations, shall be a lawful structure, and shall be recognized and known as a post route, upon which the mails, troops, and munitions of war of the United States shall be transmitted free of charge.

Right to amend, etc.

SEC. 6. That the right is hereby expressly reserved to alter, amend, or repeal this Act.

Commencement and completion.

SEC. 7. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Approved, June 9, 1897.

June 18, 1897.

CHAP. 6.—An Act To amend an Act entitled "An Act to authorize the construction of a steel bridge over the Saint Louis River between the States of Wisconsin and Minnesota," approved April twenty-fourth, eighteen hundred and ninety-four, as amended by an Act approved August fourth, eighteen hundred and ninety-four, entitled "An Act to amend an Act to authorize the construction of a steel bridge over the Saint Louis River between the States of Minnesota and Wisconsin."

Bridge across St. Louis River.
Vol. 28, pp. 65, 67.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That sections three and nine of the above-entitled original Act and section three of the same, as amended by the said Act approved August fourth, eighteen hundred and ninety-four, entitled "An Act to amend an Act to authorize the construction of a steel bridge over the Saint Louis River between the States of Minnesota and Wisconsin," be amended so as to read, respectively, as follows: Vol. 28, p. 228.

"SEC. 3. That the accessory works referred to in the preceding section shall be such booms, dikes, piers, or other suitable and proper structures for confining the flow of water to a permanent channel, and for the guiding of steamboats, rafts, and other water craft safely through the draw and rafting spans, as shall be required by the Secretary of War; and in addition thereto, and before the construction of the bridge to be built under this Act, the company or persons owning or holding such bridge shall be required, under the direction of the Secretary of War, or such officer as he shall designate, to dredge above and below said bridge to such depth and for such distance as in the judgment of the Secretary of War, or of such other officer as he shall designate, shall have been rendered necessary by the erection of the piers to said bridge." Aids to navigation. Dredging. Depth of, etc., to be determined by Secretary of War, etc.

"SEC. 9. That this Act shall be null and void if actual construction of the bridge therein authorized be not commenced within one year and completed on or before August first, anno Domini eighteen hundred and ninety-seven." Commencement and completion.

SEC. 2. That all acts or parts of acts in conflict with the provisions of this Act are hereby repealed. Repeal.

Approved, June 18, 1897.

CHAP. 7.—An Act To authorize the construction of a bridge across Pearl River, in the State of Mississippi. June 18, 1897.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the board of supervisors of Marion County, in the State of Mississippi, be, and is hereby, authorized to construct and maintain a highway bridge and approaches thereto across Pearl River, at or near the town of Columbia, in said county and State. Marion Co., Miss., may bridge Pearl River at Columbia.

SEC. 2. That said bridge shall be located and built under and subject to such regulations for the security of navigation as the Secretary of War may prescribe, and to secure that object the said board of supervisors shall submit for his examination a design and drawing of the bridge and a map of the location, and until the said plan and location are approved by him the bridge shall not be commenced or built; and should any change be made in said bridge before or after completion, such change shall be likewise subject to the approval of the Secretary of War. Secretary of War to approve plans, etc.

SEC. 3. That the said bridge shall be so kept and managed as to offer reasonable and proper means for the passage of vessels and other craft through or under the same, and for the safety of vessels passing at night there shall be displayed on said bridge, from sunset to sunrise, at the Aids to navigation. Lights.

Changes.

expense of the owners thereof, such lights or other signal as the Light-House Board may prescribe; and any changes in said bridge which the Secretary of War may, at any time, deem necessary and order in the interests of navigation shall be made by the owners thereof at their own expense.

Commencement and completion.

SEC. 4. That this Act shall be null and void if actual construction of the said bridge be not commenced in one year and completed in three years from the date hereof.

Right to amend, etc.

SEC. 5. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Approved, June 18, 1897.

July 19, 1897.

CHAP. 9.—An Act Making appropriations to supply deficiencies in the appropriations for the fiscal year ending June thirtieth, eighteen hundred and ninety-seven, and for prior years, and for other purposes.

Deficiencies appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, to supply deficiencies in the appropriations for the fiscal year eighteen hundred and ninety-seven, and for prior years, and for other objects hereinafter stated, namely:

* * * * *

Treasury Department.

TREASURY DEPARTMENT.

* * * * *

George W. Goethals.
Credit in accounts of.

CREDIT IN ACCOUNTS OF GEORGE W. GOETHALS: The Secretary of the Treasury be, and is hereby, authorized and directed, in settling the disbursing accounts of George W. Goethals, captain, Corps of Engineers, United States Army, to cause to be passed to the credit of said Captain Goethals "voucher numbered eighty-two of his accounts for disbursements for fourth quarter of eighteen hundred and ninety-two, appropriation for improving Tennessee River below Chattanooga, Tennessee, Alabama and Kentucky," being amount paid by him for expenses incurred in examining title and preparing deeds to three tracts of land purchased by the United States at Locks Two, Five, and Nine, Muscle Shoals Canal, amounting to seventy-two dollars.

Cols. C. B. Comstock and George H. Mendell.
Credit in accounts of.

CREDIT IN ACCOUNTS OF COLONEL C. B. COMSTOCK AND COLONEL GEORGE H. MENDELL: Authority is hereby granted to the proper accounting officers of the Treasury to allow and credit in the accounts of Colonel C. B. Comstock, brevet brigadier-general, United States Army, the sum of forty-two dollars, standing against him on the books of the Treasury; and to allow and credit in the accounts of Colonel George H. Mendell the sum of four hundred and seventy-two dollars, standing against him on the books of the Treasury.

Col. H. L. Abbot.
Credit in accounts of.

CREDIT IN ACCOUNTS OF COLONEL H. L. ABBOT: Authority is hereby granted to the proper accounting officers of the Treasury to allow and credit in the accounts of Colonel H. L. Abbot, brevet brigadier-general, United States Army, the sums of fifty dollars and eight cents and twelve dollars and forty eight cents, standing against him on the books of the Treasury, for disbursements on account of mileage.

Maj. Thomas W. Symons. Credit in accounts of.

CREDITS IN ACCOUNTS OF MAJ. THOMAS W. SYMONS: Authority is hereby granted to the proper accounting officers of the Treasury to allow and credit in the accounts of Maj. Thomas W. Symons, Corps of Engineers, United States Army, the sum of fifty-one dollars and fifty-two cents standing against him on the books of the Treasury for disbursements on account of mileage.

* * * * *

DISTRICT OF COLUMBIA.

District of Columbia.

Executive office. Salary of Engineer Commissioner.

EXECUTIVE OFFICE: For amount required to make the salary of the Engineer Commissioner five thousand dollars per annum, fiscal year eighteen hundred and ninety-eight, eight hundred and forty-four dollars.

For amount required to make the salary of the Engineer Commissioner five thousand dollars per annum, fiscal year eighteen hundred and ninety-seven, two hundred and seventy-nine dollars and six cents.

* * * * *

Payment for lots. Potomac River flats. Vol. 29, p. 397.

PAYMENT FOR LOTS, POTOMAC RIVER FLATS: That the Act of June eleventh, eighteen hundred and ninety-six, providing for the payment by the District of Columbia of one-half of the amount appropriated for "payment of the owners of the lots and parts of lots referred to in the decrees passed by the supreme court of the District of Columbia in the case of the United States versus Morris and others, and located in squares sixty-three, eighty-nine, one hundred and twenty-nine, and one hundred and forty-eight, in the city of Washington, in said District, which lots and parts of lots which have been included within the limits of the improvement of the Potomac River and its flats, in charge of the Secretary of War," is hereby amended so as to make the same payable wholly from the revenues of the United States.

* * * * *

WAR DEPARTMENT.

War Department.

* * * * *

Pay to officer in charge of public buildings and grounds, D. C. Vol. 29, p. 612.

PAY, MISCELLANEOUS: That the following paragraph in the "Act making appropriations for the support of the Army for the fiscal year ending June thirtieth, eighteen hundred and ninety-eight," approved March second, eighteen hundred and ninety-seven, namely: "Additional pay to officer in charge of public buildings and grounds at Washington, District of Columbia, in addition to pay as major, one thousand dollars," is hereby amended so as to read as follows: Additional pay to officer in charge of public buildings and grounds at Washington, District of

Columbia, in addition to pay as captain of engineers, one thousand seven hundred dollars.

For additional pay to officer in charge of public buildings and grounds at Washington, District of Columbia, in addition to pay as captain of engineers, five hundred and twenty-eight dollars and ninety cents.

* * * * *

Major T. W. Symons.
Credit in accounts of.

CREDIT IN THE ACCOUNTS OF MAJOR T. W. SYMONS: That the proper accounting officers of the Treasury are hereby authorized and directed to credit Major (late Captain) T. W. Symons, Corps of Engineers, United States Army, in the settlement of his public accounts with the sum of one hundred and fifty dollars, the said amount having been paid out in accordance with the orders of the Secretary of War and the provisions of the regulations for the government of the Army of the United States prescribed by the President.

* * * * *

Rivers and harbors.

RIVERS AND HARBORS.

Mississippi River.
Head of Passes to mouth of Ohio River.

IMPROVING MISSISSIPPI RIVER: For continuing improvement of Mississippi River from Head of the Passes to the the mouth of Ohio River, six hundred and twenty-five thousand dollars.

Mouth of Ohio River to St. Paul.

IMPROVING MISSISSIPPI RIVER FROM THE MOUTH OF THE OHIO RIVER TO SAINT PAUL, MINNESOTA: For continuing improvement from the mouth of the Ohio River to the mouth of the Missouri River, three hundred and twenty-five thousand dollars.

Mouth of Missouri River to St. Paul.

For continuing improvement from the mouth of the Missouri River to Saint Paul, Minnesota, two hundred thousand dollars.

Cumberland Sound.
Continuing improvement, etc.

For continuing improvement of Cumberland Sound: Fifty thousand dollars for sluicing and dredging at the entrance to said sound, in accordance with the revised project of eighteen hundred and ninety-five, as recommended in a communication from the Secretary of War to the Senate, dated June twenty-sixth, eighteen hundred and ninety-seven: *Provided*, That nothing herein contained shall be so construed as to increase the limit of cost of such improvement beyond the amount heretofore fixed by law.

Proviso.
Limit of cost.

Surveys, etc., South Pass.

EXAMINATIONS AND SURVEYS AT SOUTH PASS, MISSISSIPPI RIVER: To supply a deficiency in the permanent appropriation for securing the uninterrupted examinations and surveys at the South Pass of the Mississippi River, one thousand dollars.

Green Bay, Wis.
Vol. 29, p. 211.
Error in enrollment corrected.

To correct an error in enrolling the Act of June third, eighteen hundred and ninety-six, making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes, the sum of five thousand dollars, to be expended under and by direction of the Secretary of War in continuing the improvement of the harbor at Green Bay, Wisconsin.

The Secretary of War is authorized to pay, out of any unexpended balance of funds heretofore appropriated for improving Saint Marys River at the falls, Michigan, the cost chargeable to the defendant under the decree of the Supreme Court of the United States in the case of Gilmore G. Scranton versus Eben S. Wheeler, the said case being a suit of ejectment brought against the said Wheeler in his official capacity as the general superintendent of the Saint Marys Falls Canal, to settle the ownership of the land on which one of the Government piers is built: *Provided*, That the sum hereby authorized to be paid shall not exceed four hundred and thirty-seven dollars and sixty cents.

St. Marys River, Mich. Payment of costs of suit, etc.

Proviso. Limit.

To defray the expense of removing obstructions in the Kootenai River, above Jennings, Montana, on which vessels have been recently wrecked, the sum of five thousand dollars, or so much thereof as may be necessary.

Kootenai River, Mont.

FORTIFICATIONS.

Fortifications.

That the Secretary of War be, and he hereby is, authorized to immediately expend the appropriation of seventy-five thousand dollars made by the fortification appropriation Act, approved March third, eighteen hundred and ninety-seven, for the construction of a riprap wall for protection of the eastern beach of United States lands at Sandy Hook, New Jersey, notwithstanding that the consent of the legislature of that State required by section three hundred and fifty-five of the Revised Statutes has not been given to the purchase of the land on which the money is to be expended.

Sandy Hook, N. J. Vol. 29, p. 642. Construction of riprap wall, etc. R. S., sec. 355, p. 60.

* * * * *

CLAIMS ALLOWED BY THE AUDITOR FOR THE WAR DEPARTMENT.

Claims allowed by the Auditor for the War Department.

* * * * *

For improving Columbia River from Rock Island Rapids to Priest Rapids, Washington, fourteen dollars and thirty-seven cents.

Columbia River, Washington.

For expenses California Débris Commission, forty dollars and forty-one cents.

California Débris Commission.

* * * * *

For improving Columbia River from Rock Island Rapids to Priest Rapids, Washington, one dollar and twenty-eight cents.

Columbia River, Washington.

For survey for canal from Lake Erie to Ohio River, one hundred and ninety-nine dollars and forty-seven cents.

Survey canal, etc.

For expenses California Débris Commission, seventy-one dollars and twenty-nine cents.

California Débris Commission.

* * * * *

Approved, July 19, 1897.

RESOLUTIONS.

March 31, 1897.

[No. 6.] Joint Resolution Making appropriation for the improvement of the Mississippi River from the Head of the Passes to the mouth of the Ohio River, and to supply deficiencies in appropriations for the fiscal year ending June thirtieth, eighteen hundred and ninety-seven.

Mississippi River.

Appropriation for, from Head of Passes to mouth of Ohio River, immediately available.

Vol. 29, p. 230.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of two hundred and fifty thousand dollars be, and is hereby, appropriated, and immediately made available, for the improvement of the Mississippi River from the Head of the Passes to the mouth of the Ohio River, and expended according to the provisions of the Act "Making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," which became a law on June third, eighteen hundred and ninety-six.

To be deducted, etc.

SEC. 2. That the sum herein appropriated be deducted from the sum of two million five hundred and eighty-three thousand three hundred and thirty-three dollars authorized to be appropriated and expended for the year ending June thirtieth, eighteen hundred and ninety-eight, by the provisions of said act of June third, eighteen hundred and ninety-six.

Deficiency appropriations.

SEC. 3. That to supply deficiencies in the appropriations for the fiscal year eighteen hundred and ninety-seven, there is hereby appropriated out of any money in the Treasury not otherwise appropriated the following sums, namely:

* * * * *

Executive Mansion.

EXECUTIVE MANSION.

Refurnishing.

For refurnishing the Executive Mansion, three thousand eight hundred and seventy-five dollars, to be expended by contract or otherwise, as the President may determine.

Repairs, etc.

For repairs to the roof of the Executive Mansion, one thousand dollars

Approved, March 31, 1897.

April 7, 1897.

[No. 9.] Joint Resolution Authorizing the Secretary of War to use rations for the relief of destitute persons in the district overflowed by the Mississippi River and its tributaries and by the Red River of the North, and making an appropriation to relieve the sufferers by said overflow.

Mississippi River, floods.

Appropriation for relief of sufferers.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of two hundred thousand dollars is hereby appropriated out of any money in the Treasury not otherwise appropriated, to be expended by and under the direction of the Secretary of War in the purchase and distribution of subsistence stores to such destitute persons as may require assistance in the district overflowed by the Mississippi

River and its tributaries and by the Red River of the North, by the recent floods. And the Secretary of War is authorized to use the steamers and other boats and vessels belonging to or now employed by the Government upon the Mississippi River and its tributaries in the transportation and distribution of the supplies furnished by the United States or individuals to and among said destitute and suffering people, and he may employ such other means of transportation as he may deem necessary to carry the purpose of this Joint Resolution into effect.

Approved, April 7, 1897.

[No. 19.] Joint Resolution Granting permission for the erection of a temporary studio in the city of Washington, District of Columbia, for use in the construction and completion of the statue of General Sherman.

July 15, 1897.

Statue of General Sherman.

Permission for erection of temporary studio, etc.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War is hereby authorized to grant a permit, under such regulations as he may deem best for the public interest, to the General Sherman Statue Committee, of the Society of the Army of the Tennessee, and to the General Sherman Statue Commission, for the erection on the public grounds in the city of Washington, District of Columbia, and on such site as he may deem best, of a temporary studio for use in the construction and completion of the statue of General Sherman, for which the contract has been awarded to Mr. Carl Rohl-Smith, sculptor.

Approved, July 15, 1897.

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